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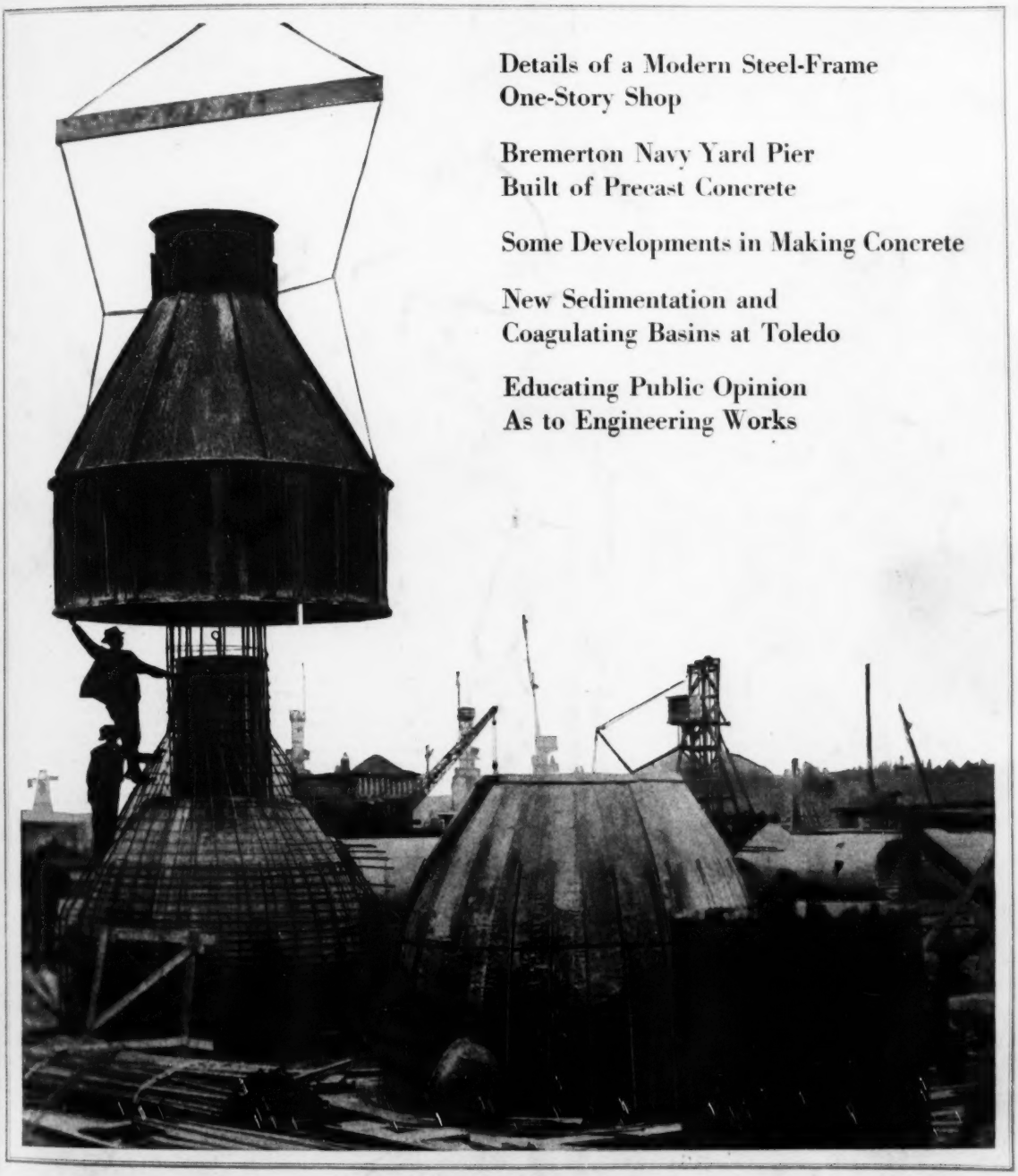
March 13, 1924

Engineering News-Record



Details of a Modern Steel-Frame One-Story Shop

Bremerton Navy Yard Pier Built of Precast Concrete

Some Developments in Making Concrete

New Sedimentation and Coagulating Basins at Toledo

Educating Public Opinion As to Engineering Works

Casting Bell Ends of Concrete Cylinders—
Bremerton, Wash., Navy Yard Pier

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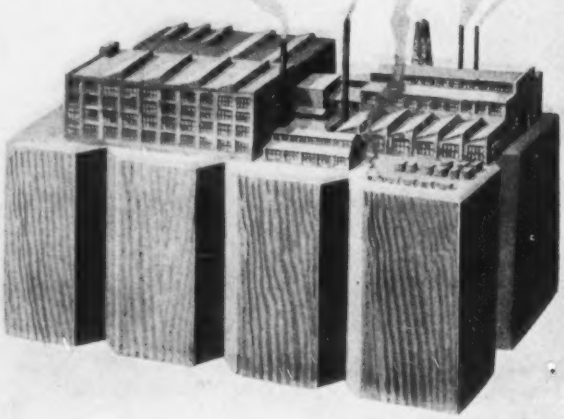

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 92 NEW YORK, MARCH 13, 1924 Number 11

An Ingenious Pier Design

EXCEPTIONALLY ingenious designing is exhibited in the revised precast concrete pier for the navy at the Bremerton yard, as described in this issue. Subaqueous and between-wind-and-water concrete on comparatively light piers subject to the shock of mooring vessels requires the most careful treatment. Most of the deteriorated concrete in seawater exposure is on such structures, where the members are light and where the possibilities of vibration are great, and not on massive concrete structures even though the saline exposure of the latter is high. The Bremerton pier design meets two of the major objections to many reinforced-concrete seawater piers; it is both massive and its exposed surfaces are of precast concrete. The massiveness insures a rigidity and a stability against local deterioration which the usual pile structure does not have, and the concrete of the precast units should be superior in texture and quality to that which is put in under water. That the design, in the figuring for estimates, proved the most economical of any studied is a third, and perhaps, commanding recommendation.

Washington Traffic Survey

THE Senate Committee on the District of Columbia has taken the logical way to solve the traffic problem of the national capital. After extended hearings the committee has recommended a thoroughgoing technical survey and fact-finding study under the engineer commissioner to provide a basis for an adequate traffic and transportation plan for the city. For the immediate needs of traffic control and accident prevention a traffic court is planned, an increase in the police force, registration of title, one-way alleys and boulevards and a stop system. Altogether the action of the Senate Committee is about as wise as could be asked. It provides for mitigating present ills and recognizes that a cure calls for much more thorough treatment, and, most important of all, comprehends that providing this cure is a highly technical problem for engineer experts. Most cities are considering nothing more—indeed, in many instances appear to be thinking no further ahead —than a palliative for traffic congestion. Perhaps the example of Washington's action will start a wider movement for a better understanding of the city-transportation problem. At least it encourages one to hope.

Australia to Set a Record

MEMORIES of the historian's dream about a future New Zealander supreme over the world are brought to mind by the news that Australia is to have by far the largest arch bridge in existence, under the contract just awarded for the harbor bridge at Sydney. It is to have an arch of 1,650 ft. span. An English concern will build it, the older community thus becoming the servant of the newer and providing the material response to the dreams and initiative of the South Sea continent. It is an interesting development in the world's work, but it is one that has been long in preparation. Much history of planning and negotiations has preceded the present event. The Sydney project has been in an active stage for some three decades, during which time a good many dollars have been taken out of the world's reserve fund to pay for preparing designs and estimates which in the end proved to be wasted. Cantilever designs held first place in attention until within two years past, and naturally so, in view of the precedents furnished by the Forth and Quebec bridges. The last call for bids, however, included an arch design on the Hell Gate model as an alternate to the cantilever. The success of this design in the competitive bidding substantiates the general opinion of the excellence of the Hell Gate type. It also supports an old principle of bridge engineering, to the effect that natural rock abutments give the arch an inherent advantage over a girder structure for efficiency. Moreover, in the present case the superior efficiency finds very obvious expression in better appearance. From a practical point of view also the final solution is satisfactory, for arch construction in steel as well as masonry rests on long experience. Nevertheless, stepping up from the 1,000-ft. span of Hell Gate to a span two-thirds larger at Sydney is a great undertaking. The resources of modern bridge practice, large as they are, will be taxed to the full in carrying it out.

Something New in Failures

FOR a long time many engineers have adhered steadfastly to the opinion that the quality of concrete is by far the biggest worry in the entire art of concrete construction. Incidents to support this opinion present themselves almost daily, in quite various ways. One of them—a new one—is the pier-seal failure which C. B. McCullough describes on p. 460; at least, some engineers will charge the failure to concrete quality in general and to as yet unknown tricks of the cement-water-aggregate triad in particular. Much tremie concrete, good, bad, and indifferent, has been put into cofferdam seals during the hundred years since the day of Joseph Aspdin, but there is no previous case in which a layer was split off from the rest by hydrostatic action and floated to the surface. Moreover, even very haphazard concretes normally have a tendency to become quite strong in two or four weeks, under conditions no more unfavorable than those set out in the description of the Oregon accident. Yet puzzling exceptions have occurred, attributed to unforseen incompatibility of the sand and the cement. In the present case, however, the laboratory evidence indicates that the sand and water were satisfactory, and as the cement passed the usual tests it is clear that everything was normal and right except the result. The suggestion is made that a heavy storm disturbed the concrete when it was two weeks old, though ordinarily even a fairly severe disturbance would not be expected to injure concrete of this age.

Since the causes of the Lewis & Clark pier-seal failure remain obscure despite the detailed explanation given in the article, it will be entirely sound to let the case serve as a fresh reminder that with concrete as with many other things it is well to get none but the best.

Make the Plant Run

UNLESS more attention is paid to the operation of sewage-works they will be condemned by the public. Particularly is this true of small plants where the incentive to spend money dies with the completion of the plant. In a paper recently read before the Wisconsin Engineering Society, T. Chalkley Hatton stated that in Milwaukee County he has found not one of the eight municipal or of the several institutional and industrial sewage-works that produces an effluent much better than the influent. Not one is operated as the engineer who designed it intended. All are neglected by the authorities. Little money is appropriated for their care. Only when nearby residents seriously complain of bad odors is any attention paid to a plant. The attendants are usually so unintelligent that they cannot be taught how to operate a sewage-works properly even were there funds to do so. Mr. Hatton recommends that the small cities (under 5,000 population) that discharge sewage into Lake Michigan or its tributaries be not required to remove more than a part of the grosser suspended and settleable solids from their sewage, leaving the finer and soluble solids to be cared for by dilution—barring nuisances and also overburdens on water purification plants. Above all he would design the sewage-works to operate with a minimum of attention. Construction is more interesting to most engineers than is operation but they must devise some way to make sewage-works run and tell the public that unless they are to be run properly it is worse than useless to build them.

Making Better Concrete

FOR a number of years past a limited number of engineers, mostly in the seclusion of the laboratory, have been working steadily on the problem of making better concrete. From time to time they have reported their results and the attendant theories. These reports have been read and discussed by a select few, most of the men working on the same problem, but the theories have been given practical application on only a small percentage of the vast yardage of concrete which is being placed. Most concrete men—designers, contractors, superintendents, engineers, foremen and workmen—not only have not attempted to apply these theories but do not know that the theories or the tests behind them even exist. Thanks to the publicity of the Portland Cement Association the work done by Professor Abrams at the Structural Materials Research Laboratory is beginning to percolate through the dense tradition of concrete making, but even that well-conducted campaign is only skimming the surface. Knowledge and practice of the other studies are confined practically entirely to the large government organizations, such as the state highway departments, who have sufficient funds to maintain a permanent testing force.

But the light is beginning to break. In the first place recognition of the need for better concrete is slowly developing. Complacent acceptance of the permanence of all the apparently good concrete placed under the varying conditions of the past twenty years is breaking down under the obvious fact that much of this concrete is far from permanent. Something was wrong with the way a lot of this concrete was made. Further than that, by such measures as we can apply, the concrete made under these old accepted methods was and is so lacking in uniformity as either to make its poorest quality unacceptable and dangerous or its average quality unduly expensive. While these facts may not even now be appreciated by the majority of concrete users they are evident to a great many more than they were a few years ago, and those who do recognize them are the most important users of the material.

To recognize that concrete is variable and that more precise methods for its manufacture are necessary is only the first step toward making better concrete. How to produce the desirable uniformity within economical limits is a much more serious problem, but to the solution of that problem many men are now directing their best efforts. Where a few years ago one or two laboratory men were working over a few test cylinders today the laboratory studies have increased ten fold and, more important still, concrete as placed in commercial practice is being controlled and tested in accordance with the latest theories. The papers at last month's meeting of the American Concrete Institute are only one instance of this awakening of interest. As abstracted on another page they do not tell the whole story but they do indicate some major phases of the problem that will bear emphasis.

Everyone will admit that the materials that go to make up concrete must be acceptable, that the water shall be pure, the sand and stone clean and reasonably hard, the mixing thorough and the cement equal to the adopted standards. There are those who feel that a higher strength, and possibly denser, concrete might be made with cements of different qualities than those set forth in the standard, but even they admit that the present standard cement makes strong concrete, the other factors being right. The questionable variable in concrete is the proportioning—the size and quantity of the aggregate and the quantity of the water to a given amount of cement.

On the details of proportioning the experts differ, but whether one accepts the theory that the water-cement proportion absolutely governs strength and that that relation is a function of the sieve analysis of the aggregate or that voids in the mortar determine strength and those voids control the optimum water content, the end result is the same—that every aggregate to be used must be analyzed, that either by mortar-void measurement or sieve analysis the proper amount of stone, cement and water must be determined to give the desired strength *with a meetable workability*. Workability thus becomes the controlling criterion. In one theory it is maintained constant by varying both water and cement but fixing the water-cement ratio; in another by varying the relative amounts of differently graded aggregate. And the latest Bureau of Standards tests seem to indicate that proper workability can be insured, without detriment to the concrete, by the judicious admixture of certain finely divided powders. In all of them workability—by whatever name—is the most important thing in making concrete; unfortunately we have no exact and always comparable method of measuring workability, but there are available rough methods and it is by no means certain that

the trained eye is not a sufficiently accurate control.

In spite of this deficiency in the new theories of proportioning, they unquestionably are leading to the making of a more uniform concrete. The several papers presented to the Institute are proof of that. They show that with careful analysis of the materials that make up the concrete, with the observance of a few simple rules during mixing and placing and with technical supervision of the testing, a concrete can be produced not only as strong as can be predicted by the method of proportioning but which will have a much smaller variation from a mean than is common in concrete as ordinarily placed. The specific method of determining the proportions is not so important; at least, the tests and studies are so conflicting that it can not be said that any one method is unassailable. But it is important that rigid adherence to specified measurements which take full account of the water in the aggregate, backed up by the best possible observance of constant workability, gives concrete which promises much better life than that mixed and placed by so-called standards of a few years ago. Further than that, this concrete approaches a uniformity which permits closer design and therefore tends to economy.

The difficulty with all of these developments is their apparent complication. For the scientifically inclined there is no difficulty in following through such involved computations and explanations as those Mr. Hunley presented in his paper on the Sidney Big Four bridge work (*Engineering News-Record*, Oct. 11, 1923) or in Professors Talbot and Richart's monograph published some months ago. But the average concrete man is appalled with the amount of work apparently behind the simple process that used to consist merely in taking one part of cement, two parts of sand and four parts of stone. He is apt to forget that this part of the work is done in the office by men trained to that kind of thinking. The field work is just as simple as it ever was, with the important exception that those at the mixer must realize that an established proportion means just that and not something more or less resembling it. And to help these field men to remember that, there are being developed weighing and measuring devices which will take the guess or the mischief out of proportioning.

The time is coming when these methods of studying aggregate will be simplified and when more men will be expert in their practice. More accurate ways of measuring the material and of standardizing workability are sure to follow. With the leaven now working so actively among the experts in this field of concrete, the mass of concrete users will naturally follow, and a better and more economical concrete will result.

A Costly Mistake

SIGNIFICANT testimony as to the growing recognition of mechanical filtration in England was given in a recent address by W. Jackson, chairman of the water committee of Birkenhead. In speaking of the removal of 1,100,000 cu.yd. of peat from the site of the reservoir known as Lake Alwen, at a cost of £100,000, Mr. Jackson said: "In view of what is now known, I think the removal of the peat was a very costly mistake; but we have learned a great deal more about the possibility of mechanical filters than was known in 1910." Had it not been for the delay occasioned by peat removal, Mr. Jackson said, probably the Alwen dam would have been completed and the pipe line to Birkenhead either completed or in a forward state before the war broke out—thus saving, we presume, a large part of the construction cost as well as making the supply available sooner than it was. "In view of the engineer's advice at the time," says London *Municipal Engineering* in a brief note on the incident, "Mr. Jackson did not blame the water committee for deciding" to remove the peat.

Neither would we presume to blame either the water committee or the water engineer of a British municipality for deciding in 1910 to spend a huge sum to remove peat or other possible trouble-making organic matter from a reservoir site but it does not seem discourteous to point out that three or four years before the Birkenhead water engineer gave the advice mentioned by Mr. Jackson two eminent American consulting engineers of international reputation (Allen Hazen and George W. Fuller) made a lengthy report on stripping reservoir sites in relation to the quality of the new Catskill water supply for New York City and advised against stripping. (The report was dated Nov. 30, 1906, and was abstracted at length in *Engineering News*, Jan. 3, 1907, pp. 8-12.) The Birkenhead and New York conditions were not strictly comparable but the Hazen-Fuller report contained data and opinion that might conceivably have had an important bearing on the Birkenhead case. However that may be, it is certain that in 1910 it was well established in America that mechanical filtration was an efficient means of removing peaty color from water—as Mr. Jackson of Birkenhead now sees, 14 years later.

Although mechanical filtration is gaining recognition in England, the largest water-works in that country, and one of the largest in the world, has but recently begun to install mechanical filters on a relatively small scale (see "London Water-Works Enlargements," *Engineering News-Record*, Feb. 28, p. 368) and even that not until after laboratory tests had been made.

Rarely if ever has a British engineer, either at his own or his city's expense, come to this country and got first-hand knowledge of American practice in either sewage or water treatment. We respectfully suggest that such inspection trips would be advantageous, both for the engineers and the municipalities they represent. We will even be so specific as to suggest that the Metropolitan Water Board might well send its filtration engineer—if it has such an expert—and its eminent director of water examinations across the Atlantic on a tour of inspection of American water treatment plants before going further with the installation of mechanical filters. Both would be suprised to see our many large mechanical filter installations, the engineering skill with which they have been designed and equipped and the engineering, chemical and bacterial supervision which is given to their operation. Seeing these things first-hand, British water-purification experts would with more self confidence and, because of their first-hand knowledge, with more conviction to their water boards or committees, recommend a reasonable breaking away from local tradition in favor of adopting and adapting in England the best of things from American water purification practice. Then it might no longer be necessary for the chairman of the water committee of a British municipality to describe a scheme adopted 14 years ago as "a costly mistake."

Bremerton Navy Yard Pier Built of Precast Concrete

Design Avoids Delays and Dangers That Menace Concrete While Setting in Tidewater—Beams, Girder Sides and Cylinders with Bell Ends Cast in Yard

By W. F. Way
Structural Engineer with Henry & McFee, Seattle, Wash.

IN THE construction of pier No. 5 at Bremerton Navy Yard on Puget Sound where the tide range is about 13 ft. studies were made to find some improved means of meeting the construction problems attendant upon concrete work of this character. Using the result of these studies Henry & McFee, the contractors, submitted a bid on an original alternate design when bids were invited on the next job of similar dimensions known as pier No. 4. This bid was based on comparative studies of plans and estimates covering several

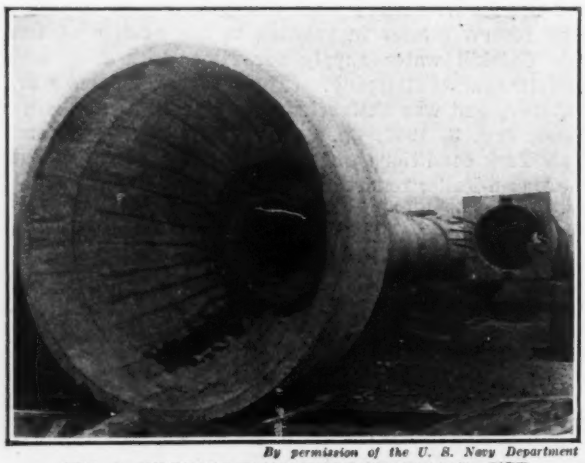

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FIG. 1—PRECAST BELL ENDS READY FOR USE
The bell end in the foreground fits over pile foundations; the square top of another cylinder appearing at the right is designed to support the girders.

different types of construction and arrangement of members. The cost ratio estimated for these several designs was found to be as follows:

3-cyl. bent 30 ft. c. to c. precast	4-cyl. bent 30 ft. c. to c. precast	3-cyl. bent 22½ ft. c. to c. precast	3-cyl. bent 15 ft. c. to c. precast	4-cyl. bent 30 ft c. to c. monolithic	4-cyl. bent 30 ft. c. to c. structure steel
1.00	1.03	1.04	1.09	1.20	1.27

In accordance with this showing the alternate bid was made on the 3-cyl. bent with the greatest possible use of precast members. After thorough checking by the Bureau of Yards and Docks, in the course of which some details were changed, the contract was awarded on the alternate design.

The general scheme was to cast the cylinder shells, girder sides, beams and braces and after these parts had been assembled in place, to pour the cores of cylinders and girders as well as the deck slab in such a way as to tie the entire structure rigidly together. The chief problem to be solved in using the precast method was the securing of rigidity and stiffness equal to that existing in a monolithic structure. Adequate stiffness is provided, it is believed, by the details of connections described in the following.

There are several advantages in addition to economy in the precast design over the structure poured in place. Some of these are: (1) The concrete has opportunity to cure thoroughly and harden before coming into contact with the salt water. (2) Better concrete is secured because the pouring is done in day shifts irrespective of tides. (3) Reinforcing steel is more accurately placed in the forms and easily and positively held in position—an important point in construction in salt water. (4) The setting of the concrete occurs on firm and unyielding supports, avoiding the damage that may result from the practically unavoidable settlement of high falsework. (5) In the precast unit it is possible to cure the concrete properly, thus securing the quality of impermeability so desirable for salt water service.

From the construction point of view there are still other advantages: (1) The precast unit requires no falsework piling for supporting formwork. (On this particular job piles would have been 100 ft. long and would have had practically no salvage value). (2) Greater speed in construction was possible, the actual time on the job being reduced two months by the precast method. (3) The cost of formwork and the placing of reinforcing steel was greatly reduced and a much cheaper system of bracing cylinders and holding them in position was possible. Finally, (4) the disadvantage of pouring through slab steel was avoided.

In the navy design the standard bent was to be made up of four cylinders, 4 ft. in diameter on 20-ft. centers.

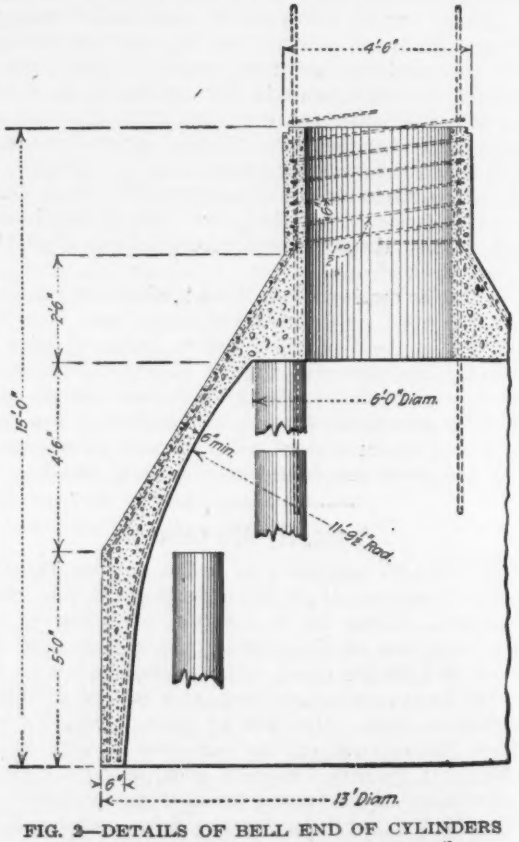

FIG. 2—DETAILS OF BELL END OF CYLINDERS
Inside pile shown is temporary supporting pile.

On account of construction costs, the contractors believed it would be advisable to use three 4½-ft. cylinders per bent and accordingly incorporated this idea in their design. Incidentally the three-cylinder design with vertical steel rearranged increases the stiffness against side thrust by about 20 per cent.

The main feature in the accepted design is the transverse girder which caps the three cylinders in each bent. The two spans of this girder are each made up of four precast pieces or sides spaced on 3-ft. centers, each 36 ft. long, 12 in. thick with arched soffits varying from 6 to 11 ft. deep, the core or central space between these two sides being later poured monolithic with the slab. The connection between the cylinder top and girder is made by extending the vertical reinforcement from the cylinder shell into the central or poured portion of the girder. In order to support and space the precast girder sides as they were erected, a 16-in. square lattice structural steel dowel was embedded in the cylinder core and extended 7 ft. into the poured portion of the girder. This made a substantial member by which the sides were held in place and it also added to the strength of the joints between cylinder and girder. Originally it was intended to use a precast concrete dowel for this purpose but this was later changed to the lattice dowel which (1) was more easily handled and (2) made it possible to carry the reinforcing and the poured concrete continuously over the joints without any interruption of the continuity of the girder core.

Although the precast sides were figured to carry the major portion of the load, provision was made for transferring load to the center by deep grooves on the inside face of the precast sides made by wood strips in the side forms. Further provision for load transfer consisted in interlocking the stirrup hooks between the two sections.

The longitudinal beams were designed as continuous members. For ease in handling it was desirable to have the bent-up rods which extended over the girders as short as possible and therefore a thorough study was made to determine the point of inflection.

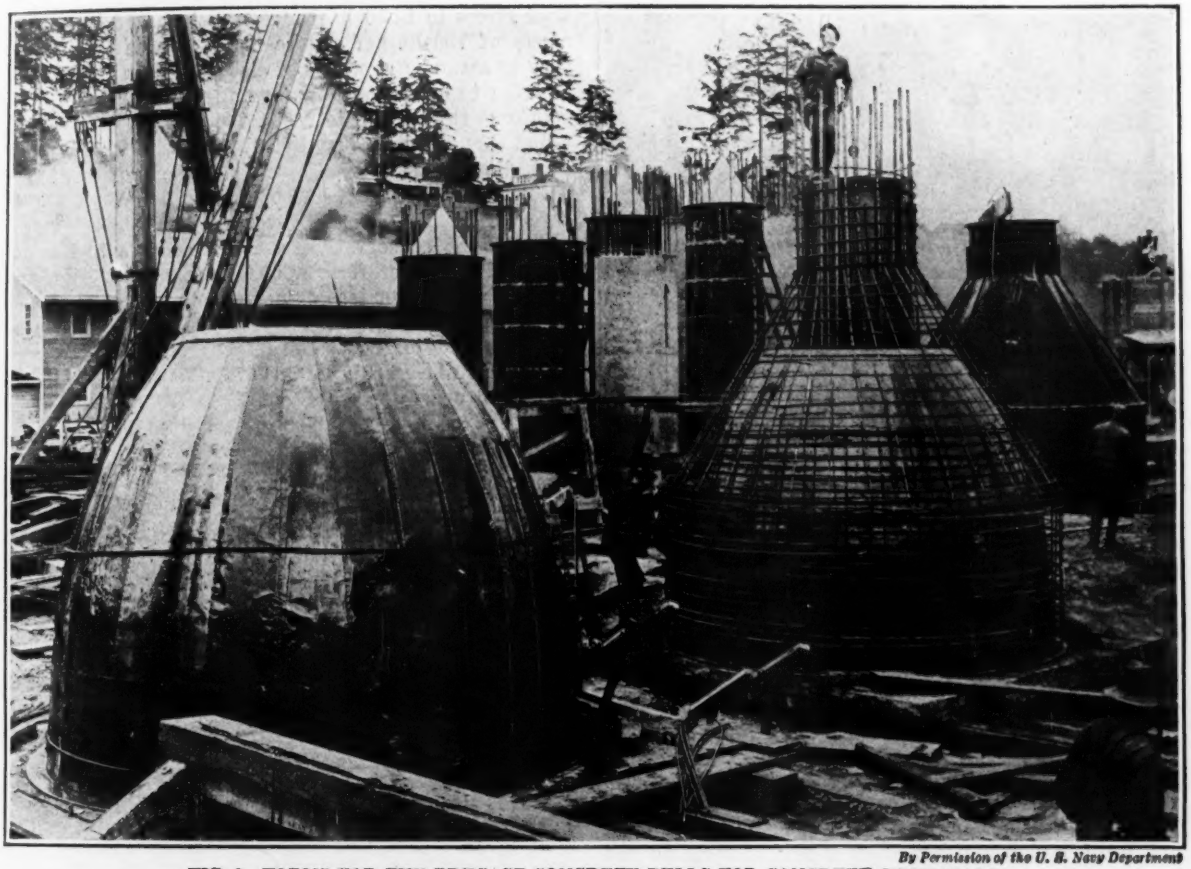

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FIG. 3—FORMS FOR THE PRECAST CONCRETE BELLS FOR CONCRETE PEDESTALS

Steel forms were used inside and outside. Reinforcing was assembled on the inner form after which the outer form was placed and bolted to the base. An outer form appears in right background, cylinder forms in center background.

All the precast members were poured in a yard about 1,500 ft. from the pier. A small working wharf was built near the casting yard and was connected to it by a standard-gage track about 350 ft. long paralleled by a narrow-gage track. The cylinders and bells were cast at the inner terminus of the track and the beams were cast along each side of it. The narrow-gage track was used exclusively for transporting concrete while the other track was used by a locomotive crane which handled reinforcing steel and forms and moved the precast beams to the loading wharf. The concrete was all mixed on a floating mixer and delivered by two 1-cu.yd. buckets mounted on a narrow-gage car.

Both the bell sections and the sections of the cyl-

inder shafts were cast vertically, subsequently being turned to a horizontal position and moved down to the ways where they were joined and left to cure. The outside forms for the cylinders and bells were made of ⅜-in. steel plate reinforced with bands and angles. The forms were joined by one vertical joint which was sprung sufficiently to allow easy stripping, this joint being fastened by clips and wedges during pouring. The inside forms for the cylindrical shaft sections were made up with center posts and hinged radial braces so that they would readily release as the derrick pulled on the center post.

On pier 4, the shape of the inside of the bell was

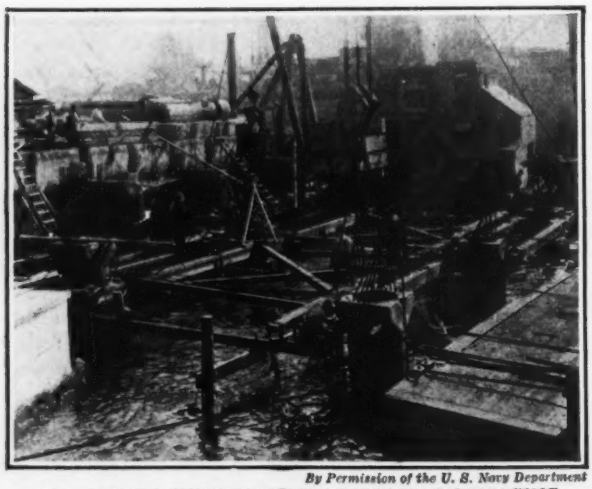

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FIG. 4—CYLINDERS HELD BY TEMPORARY BRACING
The few piles shown constitute the only temporary support required with this type of construction. Note air lock on deck in central background and method of weighting down cylinders with concrete bars.

changed from that used on pier 5. The revised section, shown in the accompanying illustrations, was better adapted to resist stresses resulting from tipping it on its side, as the thickness at the intersection of the cylindrical and conical outer surfaces where the movement is the greatest was increased from 8 to 13 in. The inside forms were made up in one piece with one vertical joint controlled by wedges and turnbuckles. This form was made of rough lumber and covered with sheet iron. Although the contact area was more than 300 sq.ft. these forms stripped very easily in one piece and were used repeatedly after a coat of form oil had been applied. This saved considerable time and expense over the previous method of segmental forms.

The spiral reinforcement for the cylinders was made up and placed in position by the derrick which then placed the vertical bars inside the spiral. After these were wired to the spiral the forms were placed by derrick, making this section ready for pouring.

The steel for the bell section was made up on the inside form as shown in the accompanying picture, and when finished the outside form was lowered into place and fastened to the base. During pouring concrete was handled in a bucket from the narrow-gage car to the form, by the derrick. The concrete was settled into position and around the reinforcing steel by vibrating the steel form with air hammers. The hardening of the concrete was accelerated by steaming the day's pours over night, care being taken to keep the temperature about body heat.

The cylinder forms and the outside bell form were removed the day after pouring. The cylinders were tipped by the derrick and rolled down the ways when they were 24 hr. old. The bells were tipped when from 45 to 72 hr. old; the inside form was then removed and the sections were skidded down the ways into position to be joined to the cylinder sections.

It is interesting to note that though the bell section weighed about 23 tons and was 13 ft. in diameter with a shell thickness varying from 6 to 13 in., not a single flexure crack developed in the handling of these pieces.

In order to determine a safe working stress for the concrete at this age, 6-in. by 12-in. test cylinders were made, cured under working conditions and broken. From these tests it was decided to limit the ultimate fiber stress to 1,300 lb. per square inch and a working stress of 750 lb. per square inch. It was then necessary to assume a modulus of elasticity for this concrete in order to compute the percentage of steel required to reinforce the section to resist the moment due to handling. As the quantity of steel is a small factor in the cost, the natural impulse is to make a conservative assumption; perhaps 2,000,000 or even 1,500,000. After careful investigations however it was found that, in order to be conservative, a high modulus had to be assumed and therefore 3,000,000 was used. For instance, with an external moment to resist of 67,500 in.-lb., $E_c = 2{,}000{,}000$, $f_c = 750$ lb. per square inch, $f_s = 20{,}000$ lb. per square inch; the required percentage of steel would be 0.00675. With the same moment and concrete stress, but $E_c = 3{,}000{,}000$, the required percentage of steel increased to 0.01 and the steel stress fell to 13,333 lb. per square inch, which is a much more conservative design and was the one used.

Each complete cylinder was made up of three precast sections and two poured joints 3 ft. in length. From the contractor's standpoint the design of the joint was a very important matter; it was undesirable to reduce the diameter of the cylinder core as this would interfere with construction operations. Also any projection on the inner surface, which was contained in the method suggested by the Navy, added considerably to the cost. Considerable study was therefore given to this detail and a very simple joint was decided upon, which proved

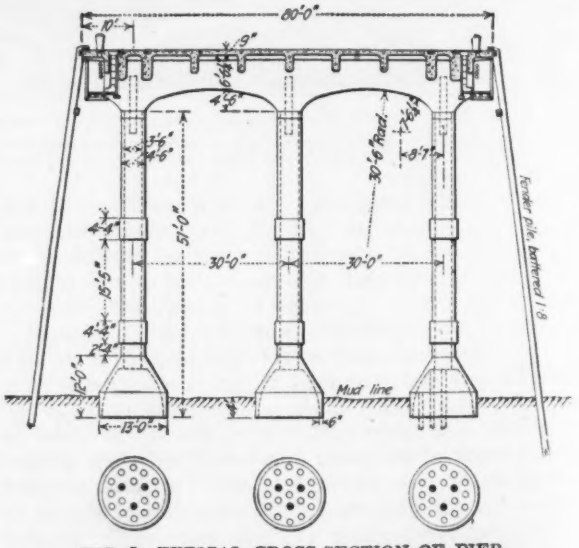

FIG. 5—TYPICAL CROSS-SECTION OF PIER
Piles shown solid are driven to exact grade and constitute supports for precast cylinder shells.

satisfactory in all respects. The vertical steel of precast sections extended 30 diameters beyond the concrete. The sections were lined and placed to make up the correct length of cylinder and in doing this the extending bars meshed together; the regular spiral was

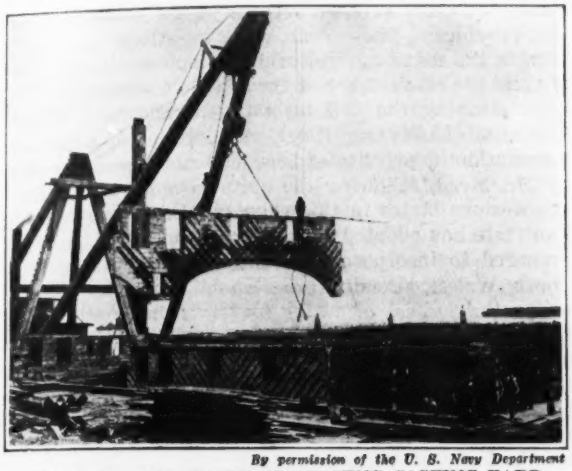

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FIG. 6—GIRDER SECTIONS LEAVING CASTING YARD
The suspended section is one of the two sides used in each span. Note grooves for bonding to central portion which is poured after these sides are supported on the cylinders.

then placed around this splice. A second spiral of slightly greater diameter than the outside diameter of the cylinder was placed over eight spacer bars bearing against the precast shells, and the whole was poured with a 3-in. concrete cover over the outer spiral, the poured concrete extending 8 in. beyond the precast sections.

The joined cylinders were cured for 30 days or more and were launched as needed by rolling slowly down the inclined ways, the rigging being such that they were under control at all times; several were, however, allowed to roll freely into the water without damage.

The transverse girder sides were cast vertically on a small platform adjacent to the working wharf, the deck of the platform being constructed to conform to the arched soffit of the girder. Starting at three points, these girders were cast in pairs, with removable forms on the outer sides. These removable forms were the ones which made the diagonal grooving in the precast girder sides mentioned in the foregoing. After 24 hr. these were taken down and a plain shiplap form, nailed to the green concrete, was substituted for them. Whereupon the removable forms were reset 13 in. from their former position and a second pair of girder sides were poured. These operations were repeated until 60 girders stood on the wharf 45x80 ft. in plan with only a 1-in. shiplap separation between them. More economical utilization of space could not well be obtained A total of 96 pieces was required.

The beams were cast on the ground along both sides of the track. The reinforcing steel was made up on frames at a central steel yard and was placed in the forms by the locomotive crane. Movable forms were used for both sides of the beams and were removed after 12 hr. by the crane which set them in position at that time for the next pour. The concrete was poured by crane with buckets. All precast members were cured by sprinkling. Most of the girders were not handled until they were six weeks old but some of the smaller beams were stored after 14 days, none being placed in the structure, however, until 30 days had elapsed after pouring.

The foundation piles were driven in clusters by a floating driver with a 50-ft. steel follower. The tops of the piles were left from 4 to 9 ft. above the mud line. It was necessary that all piles be accurately driven as the precast cylinder shells were required to fit over the clusters. Three piles in the center ring were driven to an exact predetermined grade to support the cylinder shell and thereby to bring the tops of the cylinders to the exact grade required for the precast girder sides. All pile clusters were checked by the diver before cylinders were set. Although considerable doubt and skepticism was expressed at the outset regarding the feasibility of this procedure, it was successfully accomplished as planned.

The cylinders, which weighed about 45 tons each, were picked up from the launching ways by a floating shearleg, carried in a vertical position to the site, and lowered over the pile cluster. Contrary to expectations of some, little trouble was encountered in spotting the cylinders so that they came to bearing on the piles without being thrown off by the reinforcing steel which extends into the bell core as shown on the accompanying picture.

The next problem was to hold the tops of the cylinders rigidly in true position. This was accomplished by a horizontal bracing system of cross-braces and walings supported on temporary piles, which were put in position before the cylinders arrived. As the cylinders were lowered into position they were at the same time centered between guides fastened to the outer wale and

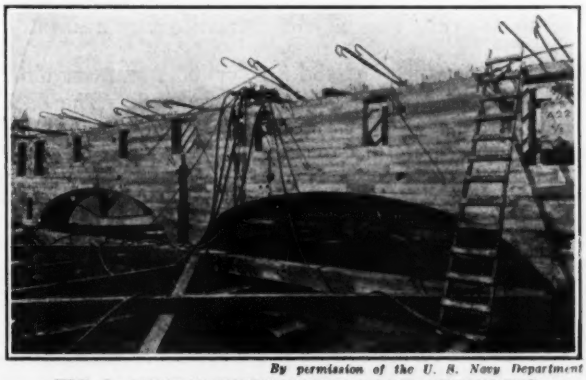

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FIG. 7—GIRDER SIDES IN PLACE ON CYLINDERS
The "windows" are for the ends of precast floor beams to be bonded into girders when concrete is poured into the central space between the girder sides.

were held there until the deck was poured. By transferring of the weight of the bracing system to a newly set cylinder, the temporary piles were released, pulled and used again. These piles were used throughout the job and then salvaged.

After the cylinders had been braced and lined, an air lock was placed in the top of a cylinder and the water and mud were forced out of the bottom by compressed air. After the inside was cleaned with fresh water, the cylinder core was filled through a ½-cu.yd. concrete lock attached to the side of the air lock. When the air lock was removed the lattice dowel was embedded in the fresh concrete, centered and braced. This lock will be described in detail in an early issue.

In order to bring the cylinders to exact grade, and also to make a good bonding surface for the mortar joints, the tops of all cylinders were chipped down

about 1 in. The plan was purposely arranged so that none of the cylinders would have to be built up to reach grade, as such construction would make a weak joint. The girders were set at low tide as the cylinder tops were 7 ft. below ordinary high water.

The precast girder sides were bolted to the lattice dowel and to each other to hold them in position and to secure rigidity. The longitudinal beams were also set by the shearleg at high water. The forms for the support of the poured portion of the girder were carried directly to and solely by the cylinders; all deck forms were carried by the precast beams. The deck and girder centers were poured, two bays at a time, by the floating plant. After the slab forms had been removed all construction joints between the precast and "poured-in-place" concrete were carefully and thoroughly cleaned and joints were filled with gunite. Remarkably rapid progress was made in assembling all precast units and pouring the deck slab. Only 76 calendar days

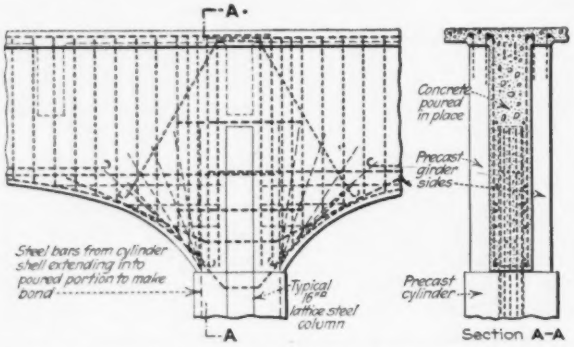


FIG. 8—STEEL FOR BONDING CYLINDER TO GIRDER

elapsed from the time the first cylinder was set until the last concrete was poured in the deck. The deck slab itself was completed in 48 days.

This design afforded an excellent opportunity to study the shrinkage stresses in the precast beams, also to determine the actual dead-load stress in the beams after the deck had been poured. The main steel in about 40 beams was gaged before the concrete was poured. Readings were taken later with a Berry strain gage at various times, the last being made when the beam carried the dead-load of the deck slab. The tests will be completed by applying a live-load. It is sufficient to say at this time that the shrinkage stresses are considerable and that the dead-load stresses in the steel are very small.

Admiral L. E. Gregory, Chief of the Bureau of Yards and Docks, approved the design of pier No. 4 after it had been checked by Capt. George A. McKay, project manager, who carefully investigated all phases of the design. The erection details and construction methods were approved by Commander R. E. Gayler, public works officer, who was represented in the field by Lieut. Allen Hoar and civilian inspector P. A. Spice. Credit is due H. M. Hadley, district engineer of the Portland Cement Association, for valuable suggestions.

For the contractors J. G. McFee, managing partner, had general supervision of the project and was assisted by Col. J. P. Mackenzie, who was superintendent and in charge of all operations except the casting yard where the work was directed by F. L. Stevens. The writer designed the pier and was also engineer for the contractor.

Improved Irrigation Development for Australia

Recommendations for bettering the irrigation development of arid regions in New South Wales have recently been made by Dr. Elwood Mead, of the University of California, in reports to the government of the province. They deal with questions considered vital to the sound agricultural development of the country and the efficient use of the available waters.

In planning the full irrigation development of the waters of the Murray River, the doctrine of water appropriation by priority of beneficial use is recommended by Dr. Mead, following the statutes and legislation of the western states in this country. So far no Australian state has adopted this doctrine but a bill has been prepared to incorporate it in the water laws of New South Wales. Pending the establishment of such a policy the success of water conservation by storage is likely to be imperiled by riparian claims. Moreover, at present it is not recognized that appropriations are limited by beneficial use actually made of them. In connection with the proposed legislation, Dr. Mead recommends that licenses by the state should be re-required for all diversions.

For the selection of areas to be developed by irrigation by the government, Dr. Mead recommends that careful soil surveys should be made as a preliminary. In large contiguous areas, some parts are favorable for agriculture and others are not, and the recommendation is that only the best should be chosen, even if in separated areas.

Settlement and agricultural development of the Murrumbidgee irrigation area on the Murray River headwaters have been so slow as to pile up large deficits in operation and fixed charges. At the beginning of the war only one-fifth of the area was settled, and at present not over one-third is settled. The English government has tentatively arranged a contract to settle 6,000 families on this area, without selection and without specified capital, the government to lend the state £6,000,000 and to guarantee the state up to £166 per settler against loss. A study of the conditions under which further settlement should be conducted indicates that settlers should be required to have at least £300 to £500 capital of their own. Statistics obtained from many other irrigated areas showed that the investment required in starting up a farm is large and that it is necessary to find means of financing the settler at a low interest rate in order that he may successfully develop the farm; and the settler's own capital must be enough to constitute him a responsible partner in the investment. A loan system is recommended.

As the region has peculiar conditions and is remote, a system of training the settlers on their own farms is proposed. Other proposals relate to co-operative enterprises in development and in wholesale purchasing, increase of alfalfa growing, government help in developing a stable market for the alfalfa, and the like. To put the entire enterprise on a sound financial footing, the report also recommends that the accumulated deficit of interest charges on the storage works (which are only in small part utilized and which serve other purposes than the irrigation) should be assumed by the state and that no further fixed charges on storage should be assessed against land until the storage is utilized. It also proposes that the commission in charge of the enterprise be given power to adjust the water charges.

Otheographic Records of Wheel Effects on Rails

Tests of Electric and Steam Locomotives—Charts Show Load and Lateral Thrust Imposed by Each Passing Wheel

IN TRIAL RUNS of electric and steam locomotives and motor cars, to test their balance and riding properties, it is important to determine the conditions of vertical load and lateral thrust exerted by the wheels on the track rails. Lateral thrust is not confined to curves, in the guiding of the engine by the wheel flanges, but may be experienced on tangent track due to a nosing movement or lateral sway of the engine. Besides the value of records of individual engines, the comparison of different types of engines as to these effects may prove of great practical value. To provide for determining and recording the load and thrust of engines in motion, a recording device known as the otheograph has been developed by the engineers of the General Electric Co. and installed in the company's 4½-mile testing track at Erie, Pa., Fig. 1. This device gives a chart showing for each wheel of the engine both the vertical load and lateral thrust.

The Otheograph—This recording instrument, Fig. 2, consists of a heavy and rigid cast steel tie with T-shaped ends, each end having two bearings 12 in. apart for the base of the rail and two similar bearings against the outside of the rail head. The vertical and horizontal deflections of the rail between these bearings operate the recording apparatus by means of springs mounted in the ends of the tie. The point of contact for the vertical deflections is under the outer side of the rail head and not under the base. For the vertical loads, springs which give ½-in. deflection for each 25,000 lb. of axle load are used with the lighter engines, or ¾ in. for each 50,000 lb. with engines of heavier loading. In each case the maximum deflection is ⅝ in. For the horizontal thrust, the springs have a deflection of ¼ in. for each 20,000 lb. of pressure. The movements of the springs under passing wheel loads are recorded through a lever having arms of 8 to 1 ratio, with a pointer at one end to trace a record on the paper chart on a revolving cylinder.

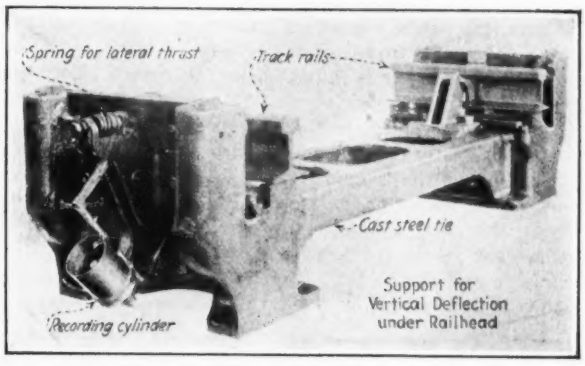


FIG. 2—STEEL TEST TIE FITTED WITH OTHEOGRAPH

In the test track there are twenty-five of these otheograph ties, spaced 24 in. c. to c. and covering about 50 ft. of track, including two rail joints. Wood ties bedded in ballast in the usual way carry two light wooden stringers upon which rest the ends of the steel ties, these stringers being used to maintain the alignment but having no appreciable stiffness. In this installation all the test ties are on tangent track, but they can be used equally well on curves.

The mechanism for revolving the charts or recording cylinders is driven from a constant-speed electric motor, with suitable gear reduction, so that the distances between the peaks on the curves are proportional to the wheel spacing on the various locomotives. Since all the cylinders are operated simultaneously they provide a series of records on successive ties for each wheel on each side of the engine. The speed of revolution is independent of the speed of the passing engine, so that records may be taken with any desired ratio between the ordinates and the abscissas. Diagrams taken in this way on any one tie show the amplitude and characteristics of both the load and thrust of all the wheels passing that tie.

The Otheograms—Typical diagrams or otheograms are shown in Figs. 3, 4 and 5, with the engines plotted upon them to show the relation of the wheels to the peaks or curves of the charts. The vertical deflection of the rail under load is recorded by the

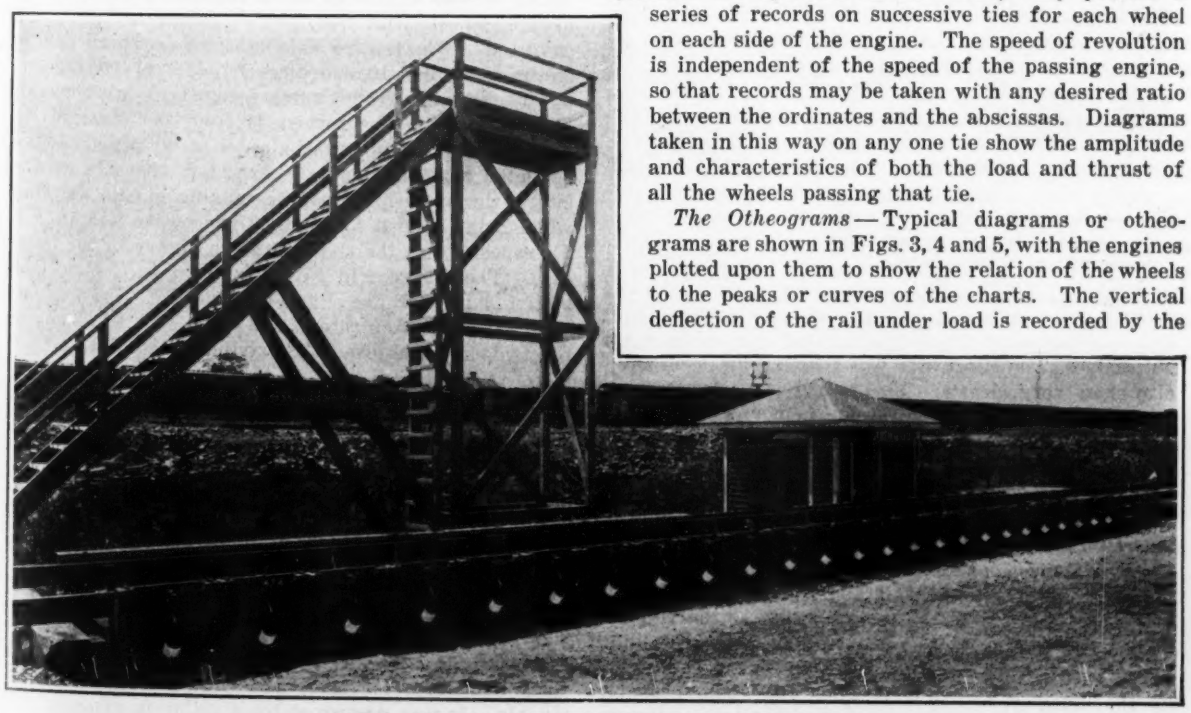


FIG. 1—OTHEOGRAPH INSTALLATION AT ERIE, PA.

bottom line, while the lateral deflection is shown at the top. All lateral thrust of the wheels outward from the center of the track is indicated by the record below the base line of the upper curve. It will be noted that at places this curve crosses the base or zero line, indicating a negative lateral movement. This is due to stressing the rail when the locomotive wheel is shifted on the rail toward the center of the track. Reference to the marks above the zero line serves as an index to the lateral movement on the corresponding otheogram taken at the opposite end of the tie. The amplitude of the records shows a multiplication of the rail movement of approximately 8 to 1. The amplitude or height of the record indicating vertical pressure is approximately 58,000 lb. per inch, while that of the curve showing lateral movement is approximately 32,000 lb. per inch.

In studying the otheograms for practical purposes, the record from a slowly moving locomotive would show the equalized distribution of the weight and such a record would serve as the basis for comparison with a record taken at high speed. The effect of side thrust in changing the vertical component, as well as any variations due to dynamic unbalance, would be quite noticeable. The effect of a wheel with a flat spot would also show very clearly. The record is not necessarily limited to one locomotive, for by moving the paper slowly the record of all the wheels of an entire train might be taken.

It is explained that the deflections shown in the upper curve, indicating lateral movement, cannot be considered quantitatively when above the base line. These negative indications simply show that the flange on the opposite side of the track is being pressed against the rail. For example, in the record shown at the right in Fig. 3 the leading truck of the steam locomotive indicates a lateral blow against the south rail. The record on the opposite end of this same tie would probably show a positive indication of lateral deflection. Due to slight inaccuracies in the recording stylus, it is necessary to take into account the starting point of the base line at the left of the otheogram. This accounts for the slightly diagonal pitch of the dotted ordinates which have been plotted on the diagram between the axles and the respective curves. Having given the outlines of the locomotives under test it is feasible to lay out a diagram showing the several wheels with reference to the impact indicated on the diagram.

In the test indicated at the right in Fig. 3, the steam locomotive was hauling a new electric locomotive built for the Mexican Ry., this latter engine regenerating during the run at a speed of 8¾ m.p.h. The electric locomotive had three two-axle trucks with 46-in. wheels and 50,000-lb. axle loads. It will be noticed that the spacing between the trucks is less than the truck spacing; that is, the truck wheelbase is 110 in. while the distance between the axles of adjacent trucks is only 78 in. The motors had pinions at each end, engaging gears on a driving shaft; this gearing was of the flexible type, designed to take up any slight variation in the machining of gears and pinions. The steam locomotive of the New York Central R.R. was of the 2:8:2 type, fitted with a booster engine on the trailing axle. It had 63-in. driving wheels with 66-in. axle spacing and 60,000-lb. axle loads. The leading axle is 9 ft. 8 in. ahead and the trailing axle 10 ft. 10 in. behind the adjacent driving axle.

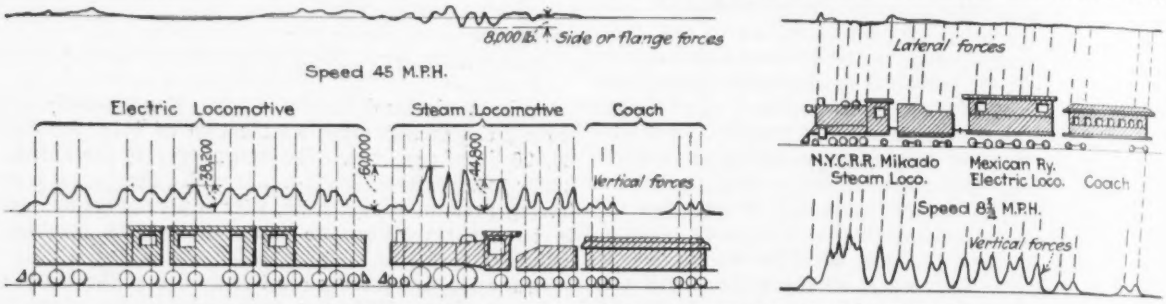


FIG. 3—DIAGRAM OF LOADS AND LATERAL THRUSTS OF ENGINE WHEELS
Left: typical records from electric and steam locomotives and coach. Right: record from steam locomotive hauling electric locomotive and passenger coach.

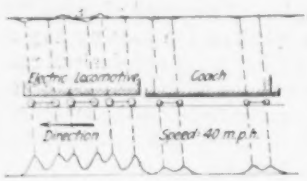


Fig. 4

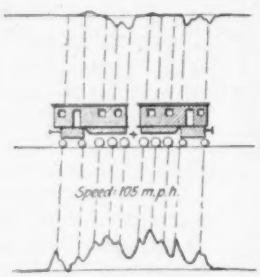


Fig. 5

FIGS. 4-5—DIAGRAMS FROM ELECTRIC LOCOMOTIVES
Left: for Mexican Ry. Right: for Paris-Orleans Ry.

Two diagrams from electric locomotives are shown in Figs. 4 and 5. The former is from the Mexican Ry. electric locomotive hauling a coach at 40 m.p.h. It will be noted that, as might be expected, there is greater lateral thrust with the engine running in this way than when being hauled by another locomotive (as in Fig. 3), especially as the speed is much higher in the latter case. The diagram in Fig. 5 is from an electric locomotive built for the Paris-Orleans Ry., France, and running at the high rate of 105 m.p.h. This last engine has two six-wheel groups of driving wheels, with a four-wheel truck at each end. In this diagram lateral thrust is indicated by the second and third driving wheels and the two wheels of the rear truck.

Passaic River Drawbridge in Two Failures

Recent failure of the swing bridge crossing the Passaic River on the Lincoln Highway, near Newark, N. J., as reported in *Engineering News-Record* of March 6, p. 421, follows a similar failure of the same structure whose repair was described April 18, 1918, p. 775. The recent report of the accident attributed the earlier failure to the Hackensack River bridge on the same road, but the latter bridge has not had any turntable trouble. It was destroyed by a colliding steamer two years ago.

New Sedimentation and Coagulating Basins at Toledo

Experience with Old Basins Utilized in Design of New Structure—Non-Baffled Units with Controlled Supply

By George Nelson Schoonmaker
Assistant Commissioner, Division of Water, Toledo, Ohio

SUPPLEMENTARY coagulating and sedimentation basins have recently been added to the Toledo filtration plant to bring this side of the treatment up to the full 56-m.g.d. capacity made available by the 1919 addition of twenty-two 1-m.g.d. filters. Experience with the two original basins was drawn upon in the design of the three new basins, which operate in parallel, are not baffled, receive a valve-controlled supply, both to mixers and settling basins, and have their sludge outlet placed at the point where measurements in the old basins indicate the maximum depth of deposit will be formed. Perforations in the stilling wall entrance to the settling basins are flared to reduce the jet velocity.

The original plant, completed in 1910, comprised twenty 1-m.g.d. units; it was augmented in 1911 by fourteen units of the same capacity. With the 1921 addition of twenty-two units the capacity exceeded that of the settling basins but the general plan of enlargement was arranged for when this latter increment was planned in 1919, the details being left until just previous to construction in 1922.

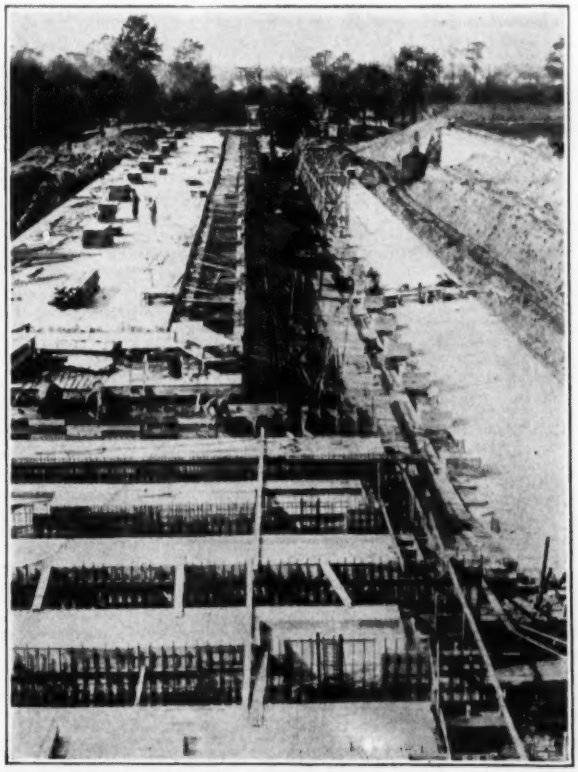
The two existing basins are each 500 ft. long, 100 ft. wide and have a water depth of 16 ft., giving a gross capacity of 6,000,000 gal. Each basin is divided longitudinally in the center by a baffle wall, so that the water enters and leaves the basin at the same end. This arrangement results in some of the volume being unavailable for sedimentation purposes, due to incomplete displacement. Taking into account the above fact, it is probable that each of the present basins, after allowing for space occupied by sediment, has an effective capacity not greatly in excess of 5,000,000 gallons.

At the time of the installation of the last twenty-two filters, provision was made for withdrawing water at the end of the first pass through each of the old basins, thus providing for a limited period of sedimentation at times when this seems desirable.

Principally the difference in arrangement of the new basins, which have a capacity slightly in excess of the old ones, is that there are three single-flow non-baffled sections through which the water will flow at a rate of 1 ft. per minute to a collecting weir and conduit to the filters at the outer end of its 500-ft. travel. The new basins are located south of and parallel to the present basins, the south wall of the present basin becoming the north wall of the new basins. Combined, the three new basins are the same length as the old ones, 500 ft., the width is 120 ft. and water depth 16½ ft. In this area are the grit chamber, baffled section and the basins proper, as shown in the drawing.

Treated water is conveyed to the new basins through a new concrete conduit, 45 in. square, connecting with the existing 54 in. steel pipe supplying the old basins. In this conduit is a concrete Venturi meter tube, square in cross-section, calibrated after installation as the meter will run in series with a standard type meter already in place.

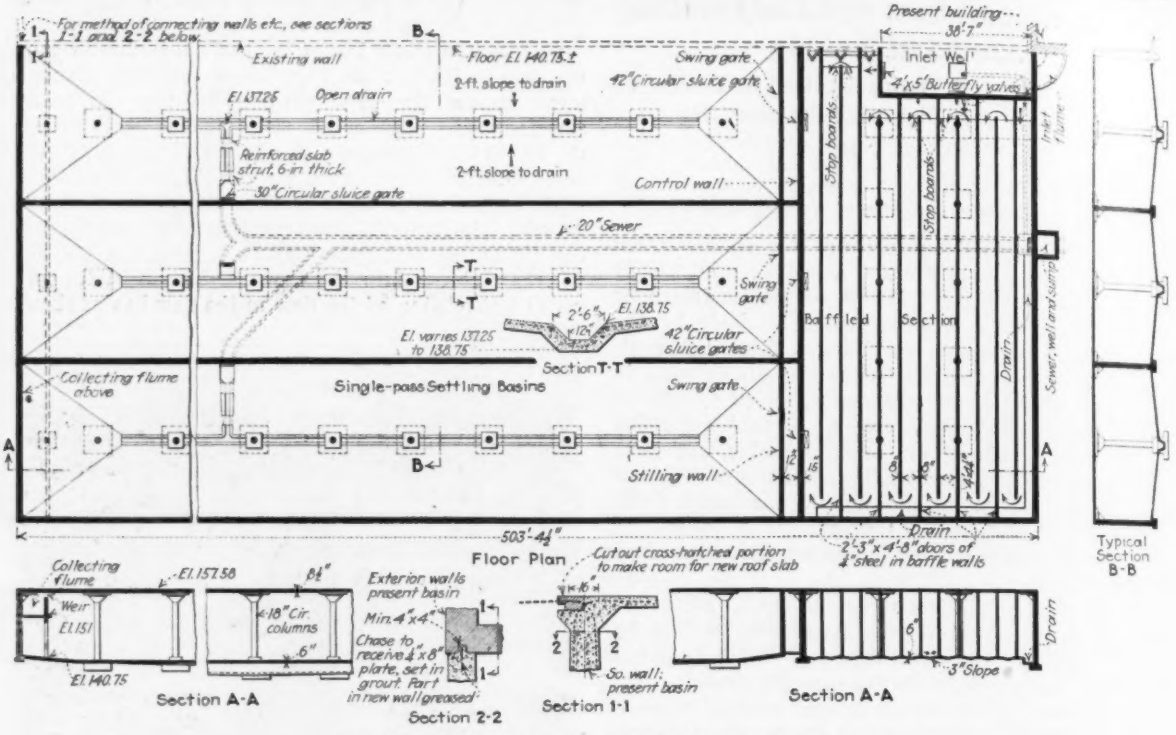
The treated water leaves the two old basins by flowing over weirs. It has been found that this arrangement divides the flow between the two old basins satisfactorily. The outlet weirs in the west end of the new basin aggregate 48 ft., thus suggesting relative capacities of the three basins (old and new) which have been assumed to be in the ratio of their widths, namely, 100-100-120. The regulation of flow through the old basins will remain as at present and the flow will be metered into the new basins. A sluice gate permits throttling of the flow to the new basins should this be found desirable. It is believed that by metering the flow through the new basins and the entire pumpage to the plant, a satisfactory subdivision of the flow through the three basins can be obtained.



TOLEDO SEDIMENTATION BASINS UNDER CONSTRUCTION

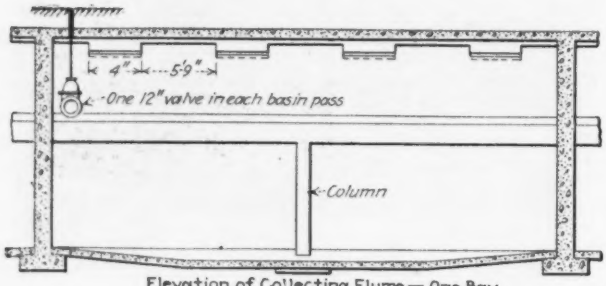
The roof is completed over south basin; the floor of second basin is in place with footings for columns over sludge channel in center, and excavation for the third basin next to existing basin is in preliminary stage. The baffled mixing chamber is foreground is only portion on which steel forms were not used.

The mixing chamber for the new basins is built across the inlet end as a single unit. From the forebay, which acts as a grit chamber, are provisions for butterfly-valve control at three points—one-third or two-thirds of the mixing chamber capacity may be bypassed. The general dimensions of the mixing chamber are 59x120 ft. in plan, and 16½ ft. in depth. The net capacity of the baffle section is 734,000 gal. When the plant is operated at the maximum capacity of 56 m.g.d. and the new basins receive only their proportionate share, the 21 m.g.d. flowing through the mixing chamber will give a retention period of 50 minutes and a velocity of 0.45 ft. per second. Eleven

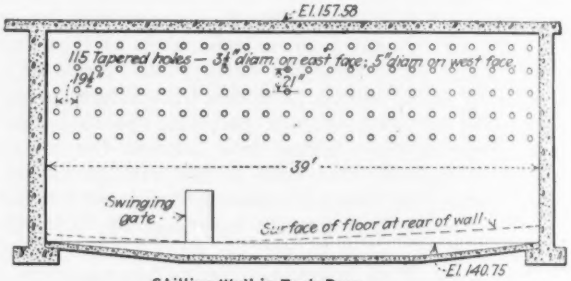


ADDITIONAL COAGULATION BASIN AT TOLEDO

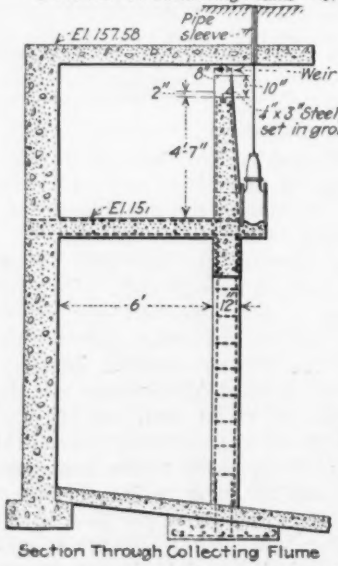
Inlet wall has three openings to baffled section to vary length of travel as desired. Ahead of stilling wall is a control wall so that any one of single pass settling basins may be put out of service.



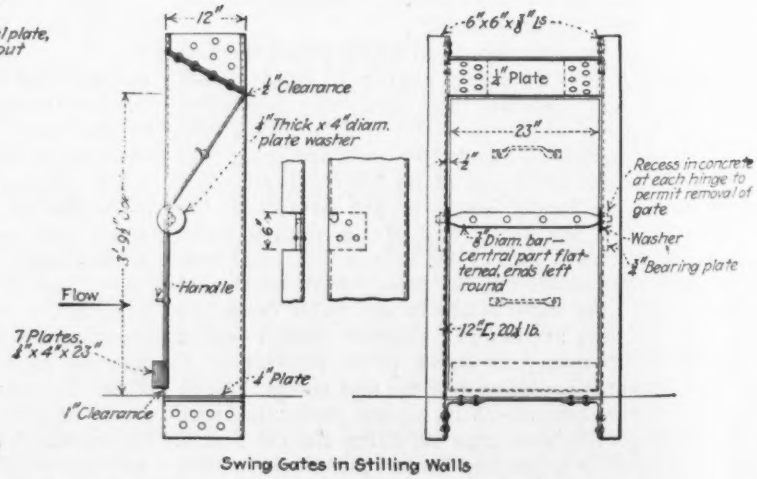
Elevation of Collecting Flume — One Bay



Stilling Wall in Each Pass



Section Through Collecting Flume



Swing Gates in Stilling Walls

DETAILS OF COLLECTING FLUMES, STILLING WALL AND SWING GATES

concrete baffles are arranged for the horizontal travel of the water, through long sections 4½ ft. in width and 16½ ft. in depth. The length of these sections varies from 106½ to 119½ ft.

Drainage for the mixing chamber is accomplished by sloping each horizontal section to the south end where a depressed channel crosses and leads back along the east wall to the main sewer passing beneath the middle of the chamber. The outlet devices from the mixing chamber consist of three sluice gate openings from the last horizontal section into three compartments located within the three units of the basin and are designed to assist in distributing the flow. The 42-in. sluice gates are set at an elevation about 3½ ft. from the bottom.

Water enters the basins proper through a perforated wall, 16 in. thick, openings in which have been designed to pass a total of 45 m.g.d. under a head of approximately 2 in. By expanding these openings from 3 in. on the inlet side to 5 in. on the discharge side it is believed that the jet action will be materially lessened, resulting in a quicker sedimentation than would otherwise be the case.

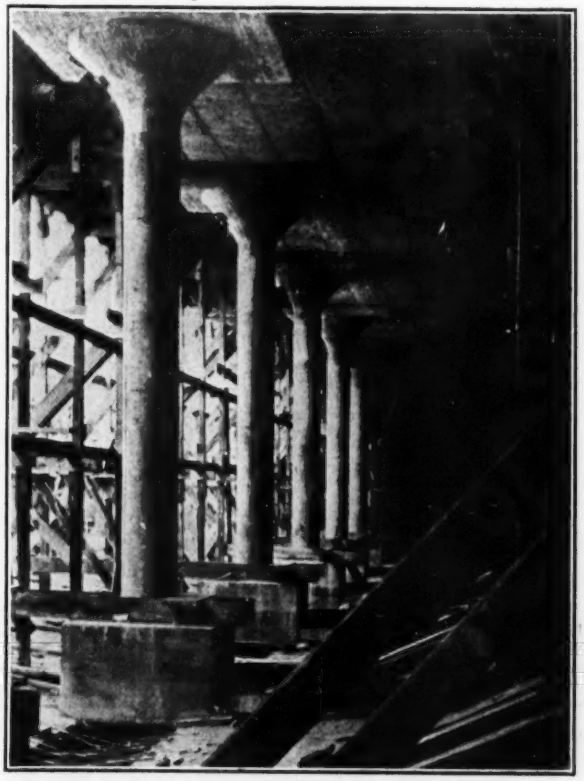
The velocity of travel through the units is 1 ft. per minute under the maximum operating conditions. As the capacity of each unit is 2,115,000 gal. when 21 m.g.d. is passing through the three units, the retention in the new basins is 7.2 hours. This is approximately the same retention period allowed for the old basins when taking their proportionate shares of the maximum capacity of the plant.

CAPACITY, VELOCITY, DETENTION PERIODS, AND LOSS OF HEAD IN NEW BASINS AT TOLEDO

Rate of Flow M.G.D.	Grit or Control Chamber, 54,000 Gal. Cap. Detention Period in Hr.	Baffle Section—734,000 Gal. Cap. Velocity f.p.s.	Baffle Section—734,000 Gal. Cap. Detention Period, Hr.	Main Basin (One of Three) 2,115,000 Gal. Cap. Velocity f.p.s.	Main Basin (One of Three) 2,115,000 Gal. Cap. Detention Period, Hr.
5	0.26	0.103	3.5	0.012	10
10	0.13	0.207	1.75	0.024	5
15	0.086	0.31	1.17	0.036	3½
30	0.043	0.62	0.59	.....	..
45	0.029	0.93	0.39	.....	..

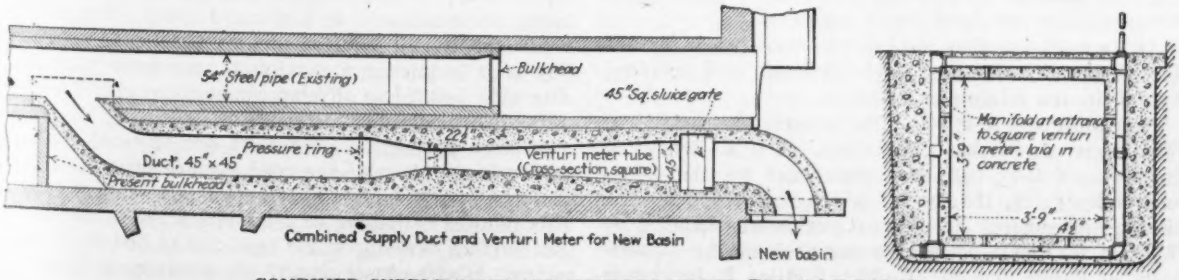
Location	15 M.G.D. 1 Basin El.	Loss	30 M.G.D. 2 Basins El.	Loss	45 M.G.D. 3 Basins El.	Loss
Collecting weirs.....	156.25		156.25		156.25	
		0.0		0.0		0.0
Basin side stilling wall....	156.25		156.25		156.25	
		0.15		0.15		0.15
Approach side stilling wall	156.4		156.4		156.4	
		0.2		0.2		0.2
Approach control wall, last baffle.....	156.5		156.6		156.6	
		0.013		0.037		0.094
Disch'ge control chamber, first baffle.....	156.613		156.637		156.694	
		0.05		0.2		0.45
Control chamber.....	156.66		156.837		157.144	
		0.04		0.17		0.37
Entrance to control chamber.....	156.7		156.007		157.514	
		0.08		0.34		0.75
Flume before venturi meter	156.78		157.347		158.264	
Total loss of head.....		0.533		1.097		2.014

At the outlet end of each unit is a collecting trough having a cross-section 4¾ ft. in depth and 6 ft. in width. Water enters the trough over four weirs for each section; each weir is 4 ft. in width, making a total weir length of 48 ft. for the new basins. This compares with 40 ft. of weir length in each of the old basins and is directly proportional to their respective capacities. When 21 m.g.d. is passing, each weir will have 4 in. of water depth over the crest. The weir is at an elevation about 13 in. beneath the under side of the slab top, leaving 9 in. to provide for losses of head and fluctuation of water level. No overflow is provided. Head losses in the mixing chamber, it is felt, will not exceed four inches.



ROUND COLUMNS WITH DROP HEADS RESTING ON HEAVY BEAMS OVER SLUDGE CHANNELS

To permit the larger valves and gates to be operated as expeditiously as possible and with a minimum of labor, it was decided to use hydraulically operated sluice gates. The three butterfly valves controlling the outlets of the grit chamber are hand operated and locked in position by the use of worm or screw gears. The



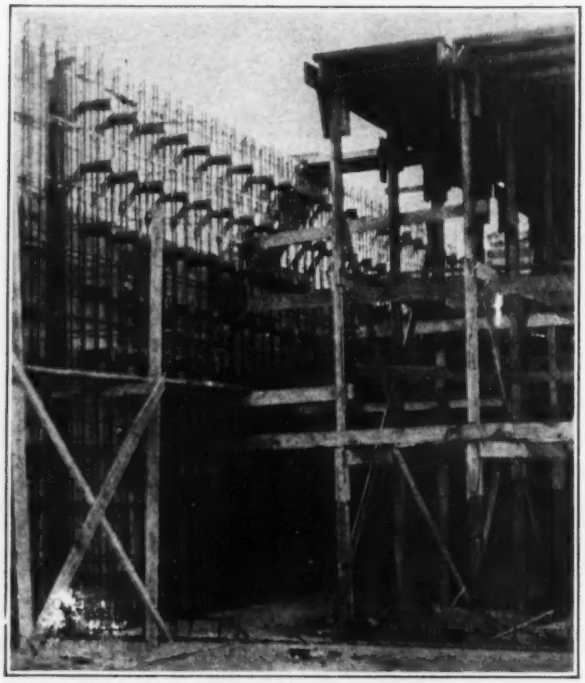
Combined Supply Duct and Venturi Meter for New Basin

COMBINED SUPPLY DUCT AND VENTURI METER FOR NEW BASIN

three sedimentation basins are provided with valves so that any one of them may be cut out of use and cleaned without interrupting the use of the other two basins.

A system of high pressure piping, with hose connections at various points, will supply water for washing down walls and assisting in the removal of sludge. After emptying the baffled section, water may be used from the grit chamber through 6-in. valves for assisting in carrying away any sludge collected in this part of the basin. The grit chamber may be emptied, drained and cleaned through a 12-in. cast-iron pipe outlet provided for this purpose.

To assist in sluicing out the sludge 12-in. valves have been provided in the settled water channel at the



METHOD OF PLACING PLUGS FOR FLARED ORIFICES IN PERFORATED STILLING WALL

west end of the basins, thus permitting settled water to be used in diluting and carrying away the sludge. To facilitate this process, the channels in the floors of the basins have been made unusually large and the floors have been given liberal slopes toward these channels.

The accompanying table shows some of the capacities of the component parts, the time consumed in passing through them at the different rates of flow, as well as the velocities and head losses produced.

In the construction steel forms were used for the flat slab roof, side and division walls and columns, except in the mixing chamber.

The work cost $144,000. The general contractor was The Henry J. Spieker Co., Toledo. The A. Bentley & Sons Co., Toledo, held the subcontract for the valves and sluice gates, the cost of which was $10,399. The design and supervision of construction was handled by William G. Clark, consulting engineer to the Department of Public Service, of which William T. Jackson is director and Frank Miller, commissioner of water.

Illinois Oiled Test Roads Give Useful Data

Analysis of Oils Used—Conclusions From Tests—Preparation for Oiling—Application and Dust Elimination

BY H. F. CLEMMER and F. L. SPERRY
Illinois Division of Highways, Springfield, Ill.

RECOGNIZING the growing importance of earth road oiling and the fact that in many cases oil is the only means at hand of improving a vast mileage of earth roads in Illinois, the State Division of Highways with the assistance of the highway authorities of Christian and Henry Counties in the spring of 1923 undertook the construction of two experimental oiled roads. One of these roads, known as the Cambridge Test Road, is located near Cambridge in Henry County, is three miles in length and is divided into 15 separate sections. The other road, known as the Rosemond Road, is located near Rosemond in Christian County in the southern part of the state and is divided into 16 sections. These roads were located with the view of securing average soil and climatic conditions existing in Illinois. Each of the 31 sections comprising the two roads has been given a different oil treatment, varying either in the kinds of oil, quantity of oil used, or the method and time of application.

This series of tests led to three conclusions: (1) An application of ¾ gal. per square yard is the minimum quantity of oil that can be expected, even under the most favorable conditions, to give results lasting through a full season on a road oiled the first time. (2) The oil treatment should not be made in one application. For the most economic results, only enough oil should be put on in the spring to carry the road through the summer and early fall and enough more added in the fall to put the road in the best possible condition to start the winter. To put on at any time less than the minimum quantity required to preserve the surface against both dust and mud, results in failure and the complete loss of whatever amount of oil has been used, and when the road is reoiled, it will require the same treatment as a road which never has been oiled. On the other hand, if one gallon of oil is put on in the spring when only ½ gal. is needed to preserve the road through the summer, no advantage will have been gained during the summer period and by fall the excess oil will have become weathered and have lost much of its effectiveness. (3) Different soil types call for widely different oil treatments and no economical or correct method of treatment can be definitely specified without taking the soil factor into account. Compact clayey soils dust but little in dry weather and require but little oil to carry them through the summer. Friable silty soils on the contrary require heavy oil treatments to prevent dusting. For winter conditions, the oil requirements are practically reversed, clay soils requiring a maximum treatment while the silty soils being less affected by moisture give good results with moderate treatments.

A large proportion of defects are traceable to improper preparation of the road surface prior to oiling. The first step should be to establish a permanent grade. This reduces reshaping to a minimum and a hard compact surface develops which need not be disturbed each spring. It also conserves any oil remaining in the road from the preceding year. No accurate data are avail-

able on the cumulative value of oil remaining in the road surface from year to year, but there are good reasons to believe that where an oiled surface remains intact a much lighter oil treatment may be required to carry it through the succeeding season.

After grading at least six weeks should elapse before applying the oil, during which time the road should be open to normal traffic and given such maintenance as may be necessary to keep the surface smooth and allow it to be compacted under traffic. Possibly a satisfactory surface might be prepared in less time by means of a roller but the method outlined was followed on both test roads and seems to be the most practical and economical.

In preparing the road for oiling, it was found that the heavier type maintainers were more satisfactory in eliminating deep ruts and were more effective in eliminating waviness. The usual types of road drags and patrol graders were not heavy enough to do the work where the surface was very rough or badly rutted nor did the light machines entirely eliminate waviness or give an especially smooth surface.

ANALYSIS OF TYPICAL ROAD OILS USED ON ILLINOIS EXPERIMENTAL ROADS

Kind and Sp.Gr. at 25 Deg. C.	Engler Sp. Visc. at 60 Deg. C.	P.C. Total Bit.	P.C. Bit. insol. in 86 Deg. Naphtha	P.C. Fixed Carbon	P.C. 5-hr. Evap. Loss	Flash Point, Deg. C.	P.C. Solid Residue 100 Pen.	Duct, Solid Residue, cm.	Grade
(a) 0.938	13.7	99.9	2.9	2.9	....	190	56	11	E-2
(a) 0.939	21.4	99.7	1.4	2.9	....	210	67	13	E-3
(a) 0.954	21.8	99.8	7.9	6.1	....	177	68	18	E-3
(a) 0.939	31.5	99.6	1.4	2.2	....	238	68	22	*
(b) 0.945	10.3	99.5	6.1	4.0	....	155	62	2	E-2
(b) 0.948	18.1	99.3	5.6	4.1	....	195	69	2	E-3
(c) 1.031	11.3	99.9	12.5	8.7	....	185	63	100	E-2
(c) 1.043	22.1	99.9	13.1	8.9	....	195	68	100	E-3
(c) 1.055	32.6	99.7	17.1	10.9	....	185	72	100	*
(d) 0.961	15.6	99.8	14.9	7.5	15.2	98	59	87	E-2
(e) 0.963	23.5	99.9	15.6	8.0	5.6	105	63	100	E-3
(f) 0.953	21.6	99.8	9.6	6.0	....	133	63	36	E-3
(f) 0.938	10.3	99.9	6.7	4.3	5.4	95	55	42	E-2
(a) 0.943	13.6	99.9	8.6	5.1	....	129	58	41	E-2

(a) Straight run semi-asphaltic residuum.
(b) Cracked semi-asphaltic residuum.
(c) Burton process pressure tar.
(d) Cut-back, Mexican asphaltic oil.
(e) Mexican pure asphalt base oil.
(f) Mid-Continent-Mexican Blend.
* Extra heavy grade.

One of the most common faults of oiled roads is that they are excessively crowned. The best of oiled roads are slippery at times and the steep crown makes them extremely dangerous to traffic. On the other hand, an oiled road must have enough crown to provide quick surface drainage. Results obtained on the test roads indicate that a crown of ¾ in. to 1 in. per foot is satisfactory. A roadway 24 ft. wide would then have a crown between 9 and 12 in. This provides adequate surface drainage and at the same time affords safety to traffic. A good oiled wearing surface cannot be built but must be developed under traffic. The constant ironing effect of rubber-tired vehicles is essential to the formation of a good wearing surface. To accomplish this result traffic must be well distributed and not follow tracks.

Application of Oil—Methods of applying oil on earth roads in Illinois are substantially as follows: The oil is heated by steam, in the tank cars in which it is received, to a temperature between 120 deg. and 200 deg. F., depending on weather conditions and the consistency of the oil, and is applied with specially designed pressure distributors mounted preferably on light, speedy motor trucks. One quarter gallon of oil per yard is distributed at each application, allowing only enough time between applications for the oil to be absorbed. Usually ¼ gal. per square yard is used as a treatment in the spring. If more oil is used, it is applied in one or more applications later in the season, ½ to ¾ gal. per yard constituting the average annual treatment. Usually the road is closed to traffic during oiling operations and for about two days thereafter to allow for complete absorption of the oil. Where the width of the road permits, it is becoming the practice to oil one side at a time, thereby eliminating the necessity of closing the road and marking detours.

Dust Elimination Prior to Oiling—It is necessary that the surface be entirely free from dust before it can be successfully oiled. Two kinds of dust are encountered in earth road oiling. First is the plain dust occurring on untreated roads which is laid with each shower, and under normal weather conditions showers are sufficiently frequent in occurrence to prevent the dust from interfering seriously with oiling operations. The other variety is the oily dust which occurs on roads which have been oiled and for some reason or another have dusted. This oily dust is not affected by an ordinary amount of rain and must be removed by mechanical means.

The method of preparing for oiling the dusty sections on the experimental road consisted simply of scraping the dust to the shoulders by means of a patrol grader and depositing the dust in a windrow just outside of the strip to be oiled, and after applying the oil, dragging it back and distributing it evenly over the fresh coat of oil. Care was taken not to apply more dust than the oil would absorb. Immediately after covering the oil with dust, the road was opened to traffic and it was found that the surface quickly ironed out into a perfectly smooth and dustless surface. By this method of handling the dust, any oil contained in it is conserved and the dust is disposed of without leaving it on the shoulders to obstruct surface drainage.

Preventing Brittleness in Malleable Iron

Leslie H. Marshall recently investigated at the Bureau of Standards the conditions under which malleable cast iron is made brittle by hot-dip galvanizing and how this embrittling may be remedied or prevented. His work is reported in Technologic Paper 245 of the Bureau, just issued. In the experiments brittleness was measured by the Izod notched-bar impact test. It was early found that quenching from a temperature of 860 deg. F. reduced the impact resistance of malleable iron to 10 per cent of its initial value regardless of whether the heating and quenching occurred in the course of the hot-dip galvanizing treatment or in any other way. Variations in rate of heating or in length of time of holding at full temperature did not alter this effect. Slower cooling resulted in less extreme brittleness. The temperature from which the quenching was done was of decided influence on the result, however, the temperature range of 700 to 1,020 deg. F. producing very low impact values, while quenching from higher temperatures not only produced no brittleness but increased the impact resistance of the iron. It was then found that a specimen which had been rendered brittle could be restored to full impact resistance by heating to the higher temperature and quenching. Further, a specimen quenched from the higher temperature before being given the embrittling treatment (or before galvanizing) did not become brittle.

Some Developments in Making Concrete

Abstracts of Five Papers and Committee Reports Presented at the Twentieth Annual Convention of the American Concrete Institute, Chicago, Feb. 25-28, 1924

Principles of Design of Concrete Plant

Report of Committee C-1, On Contractor's Plant

PLANT design involves not merely the question of equipment but also of men, and the proper combination and co-ordination of the two.

Construction of any sort is essentially a manufacturing proposition and the elements which enter into the design and layout of machinery in a fixed manufacturing plant are the same as those which enter into the design and layout of a plant for construction purposes,—with this difference—plant on a construction job is temporary and the ease of dismantling is to be considered as much as the cost of erection.

TABLE I—INFORMATION DESIRED

1. Quantity materials needed—general { steel; lumber, brick and tile; cement; sand and gravel
2. Source raw materials or derivatives.
3. Location of these materials in finished structure.
4. Methods of transportation available.
5. Methods of handling that are available.
6. Space available—storage { traffic conditions; weather conditions; labor conditions
7. Power available.
8. Layout of ground.
9. Probable weather conditions.
10. Probable labor conditions.
11. Special consideration { Sequence of work; Relation to other work; Finished floors; Size sections

Knowing then these considerations entering into any construction work it is next necessary to obtain certain preliminary information and also, to carefully weigh various matters having to do with the efficient operation of the plant.

TABLE II—POINTS TO BE CONSIDERED IN DETAIL BEFORE MAKING FINAL DECISION ON PLANT

1. Costs of various installations { Rental { first cost, salvage, interest; Installation and removal; Maintenance; Operation
2. Reserve supply { Weather; Labor; Traffic conditions; Convenience heating
3. Convenience in weather protection { cold; rain
4. Few bottleneck equipments to avoid conjection or to replace in case of breakdown.
5. Accessibility for repairs.
6. Co-ordination balancing all facilities.
7. Uniformity of mix.
8. Proportioning.
9. Location so as to reach all parts of work with all materials.

An analysis consists of two distinct steps which are separated as shown in the two tables attached: Table I—Information desired, and Table II—The various points to be considered in detail before making final decision on plant, with the various sub-headings under each of these major sub-divisions as shown in the outline.

* * *

Suggestions for Producing Better Concrete

Report of Committee C-6, On Field Methods

BETTER concrete needs to be defined, for it is still generally thought, erroneously, that better concrete is synonymous with increased cost and production. The deficiency of concrete is the extreme variation of its quality and not a consistent inferiority: the potential qualities are not, therefore, fully available.

Better concrete can be defined as a concrete the properties of which are so nearly constant that they can be fully taken advantage of in design.

It is self-evident that, if concrete of predetermined and constant quality is to obtain, the characteristics of the material must govern in the determination of proportions, and methods must be used to insure constancy of operation throughout the making of concrete.

The production of constant concrete is then based on the following:

(1) A complete knowledge of the concrete making qualities of the available materials.

(2) The application of the scientific principles governing concrete to the determination of the proper combination of the available materials to result in a concrete of the desired quality.

(3) Methods of handling the materials which will maintain the established proportions and insure homogeneity of the concrete to the place of depositing.

It will be of interest to demonstrate:

(1) How far short the present specifications and methods of making concrete fall from meeting the above mentioned requirements.

(2) The fact that in almost every instance a considerable waste of money results from the utter disregard of these rules.

The popular forms of specification in vogue today are to a large extent responsible for the furtherance of the wasteful and inaccurate methods used.

They place restrictions on the gradings of aggregate which are meaningless and expensive.

They stipulate arbitrary proportions, independent of the nature of the materials, and they leave unmentioned the most important factors which control the quality and cost of concrete.

It is not generally known, but nevertheless a fact, that good concrete can be made with almost any sort of clean, sound and stable aggregate, if sufficient cement is used. The grading of the aggregate, by virtue of the fact that the amount of cement required is dependent upon it, is more a matter of economy than one of regulation. The grading of the entire aggregates (fine and coarse) which proves most economical is that which produces a mixture of particles from fine to coarse having the greatest density or nearly so.

In general, the influence the properties of the constituent of concrete have on the quality of the resulting concrete are as follows:

The cleanliness of the aggregate, its hardness and durability are fundamental requirements.

The relation that the strength of the resulting concrete bears to the proportion, size and grading of the ingredients is:

(1) That the strength of the concrete varies in an inverse ratio to the amount of water used with a given quantity of cement.

(2) That the amount of water required to produce concrete of a given plasticity is a function of the grading and maximum size of the aggregates.

The ratio and function above referred to have been sufficiently well established to form the basis for the determination of correct and economical concrete mixtures.

Concrete specifications, embodying the above requirements, may be expressed as follows:

The aggregate shall be clean, hard and durable. The largest particles shall be as large as the type of structure will permit. The proportion of fine to coarse aggregate shall be such that the density of the total aggregate shall be a maximum and sufficient cement, and water in a predetermined ratio depending upon the quality of cement, and the strength of concrete desired shall be added to produce a mixture of proper flowability consistent with the nature of the work..

The method of procedure, therefore, in determining concrete mixtures is as follows:

(1) Select an aggregate the size of the largest particle being as large as the work will permit.

(2) Determine the ratio of fine to coarse aggregate which will produce the greatest density.

(3) Add cement and water in a predetermined ratio, dependent upon the strength desired, to the aggregate to produce a mixture of such plasticity as is most suitable for proper depositing in the work.

An economical mixture is one in which a minimum amount of cement is used and, since the ratio of water to concrete is definite for a given strength, the drier the concrete, the less cement is required.

In a given volume of concrete, the greater the volume of aggregate the smaller the amount of cement and water will it contain.

It follows then that the most economical concrete of a given quality is that in which the aggregate is graded to a maximum density and mixed as dry as is consistent with the field requirements.

A simple method of determining the economical proportions to meet the above requirements is given below. This method has been tried out and has yielded results which warrant its recommendation by the committee.

Having selected clean, hard and durable aggregates, combine varying proportions of the dry, fine and coarse until a proportion is reached which gives the densest mixture, i.e., that which weights most per unit of volume.

To this densest mixture add varying amounts of a cement paste (cement and water), premixed in the ratio corresponding to the strength required, until the desired plasticity is obtained.

From the weight of a unit volume of the concrete thus obtained and the weights of the ingredients it contains, derive the proportions and material factors.

The determination requires a very nominal equipment and may be conducted in the field in a very short time, thereby making it possible to make such corrections in the proportions as may be necessary due to changes in the characteristics of the materials or working conditions, thereby maintaining the quality of the concrete uniform and the cost as low as possible.

* * *

Field Tests of Concrete

By John G. Ahlers
Barney-Ahlers Construction Corporation, New York City

and Stanton Walker
Associate Engineer, Structural Materials Research Laboratory, Chicago

Tests made during the summer and fall of 1923 in New York City through the co-operation of the New York Group of Contractors; and the Structural Materials Research Laboratory, Lewis Institute, Chicago.

IN THE summer and fall of 1923 strength tests of concrete were made during the period of construction of five reinforced-concrete buildings in New York City. These tests were an outgrowth of an extensive series of field investigations undertaken to establish means of introducing into practice some of the improvements in the technique of concrete-making, which recent researches have indicated are desirable and to determine the practicability of securing the compressive strength desired in concrete produced under field conditions.

Description of Tests—This investigation involved the manufacture of about 650 6x12-in. concrete cylinders for compression tests, sieve analyses of about 190 samples of aggregate, and the numerous miscellaneous determinations necessary to furnish complete information from which an intelligent analysis of the test results could be made.

All of the tests were made on reinforced-concrete structures for which concrete of a relatively high degree of workability was required. In general, the slump was 6 to 7 in. For four of the jobs the aggregate was siliceous sand and pebbles from Long Island; for the fifth the aggregate was sand and pebbles of a dolomitic nature from Marlborough on the Hudson River. Portland cement was used. Most of the concrete tested was of mixtures assumed to be equivalent to the usual 1: 2: 4. All concrete was machine-mixed in batch mixers.

The operations involved in obtaining the necessary information for the design and control of the concrete proportions are:

Aggregate
- Sampling
- Sieve Analyses
- Unit Weight
- Moisture Content
- Absorption
- Colorimetric Test for Organic Impurities

Design of Proportions

Calibration of Measuring Devices for Aggregate, Water and Cement

Concrete
- Sampling
- Determination of Workability of Concrete by Slump or Flow Test

Compression Specimens
- Molding
- Curing
- Testing

Conclusions—In applying the results of this investigation to the general problem of field control of concrete, the conditions under which it was carried out should be kept in mind. The tests were made on work under construction by high-grade contractors, in a district where aggregates of excellent physical qualities are used. Trained organizations of long experience and adequate equipment for proportioning and mixing the concrete as measured by present standards, were used. The following conclusions may be stated:

1. On these five jobs, where trained organizations of long experience were used, the proportions and methods employed, based on experience only, gave concrete having an average strength from 6 to 18 per cent greater than that assumed for purposes of design. It is noteworthy in this connection that many of the objectionable practices which account for unsatisfactory concrete, were not encountered on these tests.

2. With the concreting methods used on these jobs, it would be fair to expect a uniformity of strength such that not less than 75 per cent of the test specimens would fall within 20 per cent of the average strength, and not more than 5 per cent would fall below a minimum value, computed on the basis of the Joint Committee Tables of Proportions (also published in Bulletin 9, of the Structural Materials Research Laboratory).

3. A study of the proportions and the materials carried out in the light of knowledge now available will enable the engineer to estimate within 20 per cent the average strength of the concrete when made in accordance with the general practices followed on these jobs.

4. Estimates of the concrete strengths made for the five jobs on which tests were carried out when compared with the strengths obtained, show that the water-ratio offers a practical basis for estimating the strength of concrete, if aggregates of suitable physical structure are used.

5. The fineness modulus is an accurate "yard-stick" for measuring the grading of aggregate for the purpose of determining the economical proportions of fine to coarse.

6. The maximum permissible values of fineness modulus given in Table 3, Bulletin 1, of the Structural Materials Research Laboratory may be satisfactorily applied to building construction. These values of fineness modulus produce concrete which works somewhat more harshly than that to which the mechanics are accustomed, and in certain cases a campaign of education may be desirable before the maximum values given by Table 3 are used. Reduction of these maximum values by 0.25 produces concrete which is easily worked into the forms in building construction.

7. Concrete designed under the conditions encountered in this investigation gave strengths well above the value in the Joint Committee Tables of Proportions.

8. The variations in strength shown by the individual specimens for different batches were, in general, the result of accidental variations in the proportions; the satisfactory agreement of different specimens from the same batch indicate that the variations were not due to the test methods employed.

9. A device which will insure a uniform quantity of aggregate from batch to batch will be of material assistance in securing concrete of uniform strength. Hoppers having vertical sides and provided with a mechanical strike-off are practicable and offer great advantages over present methods. Uniformity in the volume of sand can be maintained by the inundation method of measurement.

10. In order to secure concrete of uniform quality with the least cost for proper control, uniformly graded aggregate should be furnished throughout the course of the work. The specifications for grading should be drawn to conform to the most economical proportions for the aggregate available. It is neither necessary nor desirable to apply the same specification for grading in all cases, as concrete of the same quality can be made from aggregates of a wide range in grading and other characteristics.

11. It is not practicable to adjust the proportions on the job to compensate for variations in the grading of the aggregate which may occur from batch to batch. However, it is feasible to modify the proportions to compensate for variations in grading occurring in different scow loads or other lots of considerable size, where each lot is uniform within itself.

12. For large concrete jobs preliminary studies should be made of the aggregate at the source of supply for the purpose of determining economical proportions.

13. Scientific control can best be accomplished by using a testing organization outside that of the owner or contractor. Provision in the contract for an equitable division of the expense of scientific control, will greatly facilitate such control.

14. The experience obtained during this investigation shows conclusively the vital importance of making tests on the job to determine the strength of the concrete used. This is evident from a consideration of the definite economies which may be effected in proportioning the concrete and in designing the structure to take advantage of the known strength of the structural material employed. Definite strengths can be obtained only by: (1) rigid inspection and (2) tests of the concrete.

* * *

Economic Value of Admixtures in Concrete

By J. C. Pearson and Frank A. Hitchcock
U. S. Bureau of Standards, Washington, D. C.

BY ADMIXTURES we mean substances other than cement, aggregates and water which are added to concrete mixtures for the purpose of imparting to the latter certain improved qualities. Admixtures of many different kinds have been marketed and used, but we are more accustomed to think of the term as applying to finely divided materials, of which hydrated lime is probably the most familiar example. Such admixtures are claimed to improve the plasticity or workability of concrete and mortars, and there is no doubt that this effect is pronounced in the case of mortars. Nevertheless it is a fact that this property is not readily susceptible of measurement, and so far as we are aware, no method has been devised for determining which of two mortars, nearly alike in plasticity or workability, is actually superior in this respect. (To avoid confusion we shall consider plasticity and workability to have the same meaning throughout this discussion.)

This question is of considerable economic importance, for if by any means a mortar or concrete mixture can be made more plastic and still serve its ultimate purpose satisfactorily, it means a saving in labor cost, and a more uniform product under given labor conditions. We believe that the importance of this question has been grossly underestimated, probably for the reason that there has been no answer to it.

About two years ago the authors seriously took up the problem of finding a method of comparing the workability of concrete mixtures. Previous to that time abortive and unsuccessful attempts to measure this quality had led to a single conclusion—that the difference in workability was there, and that neither the slump test nor the flow table furnished any information on this elusive property. We knew, as everyone knows, that a 1: 2: 4 mixture of a given slump or flow or "consistency" was easier to mix and place in forms than a 1: 3: 6 mixture of similar consistency, but what was it that one could put his finger on and *measure*, to demonstrate that the former was easier to handle and place in forms? We tried many methods—direct methods, such as measuring the amount of work necessary to move a concrete mixture from one place to another; but this failed because we could not tell when the transfer had been completed. We tried indirect methods, such as measuring the tendency of the concrete to retain its mixing water in a filter; we had fair success with methods of measuring segregation, but these failed when the concrete approached anywhere near the same degree of workability. After much study we came to the conclusion that the most obvious difference between concretes or different workability was the tendency of the harsher mixes to allow their solid constituents to settle and pack at the bottom of the mass. Then followed a search for a method of measuring this packing, and finally we devised a simple penetration test which was described last year before the American Society for Testing Materials (*Engineering News-Record*, July 26, 1923, p. 145).

[As a result of a series of experiments with this instrument the authors came to the following conclusions.]

Conclusions—(1) The workability of any concrete mixture is about equally benefited by one part of celite, two parts of kaolin, or three parts of hydrated lime, such as used in these tests, if the consistency as measured by the flow table is kept constant. Under the same conditions plain calcium chloride did not improve the workability, whereas of two proprietary chloride compounds used one was found to give a very appreciable improvement and the other quite a marked improvement.

(2) The powdered admixtures in the proportions used did not seriously affect the strength of 1: 2: 4 or leaner concretes; in fact the 1: 3: 6 concretes were benefited by the admixtures in all cases. Considerable reduction in strength resulted from the larger proportions of the admixtures in 1: 1½: 3 concrete. The results indicate that a judicious use of admixtures in concretes which need improvement in respect to workability will not materially impair the strength. The chloride admixtures without exception produced a considerable increase in strength.

(3) The slight tendency toward reduction in strength of concretes containing the powdered admixtures was if anything more pronounced under dry or partially dry curing conditions than under damp storage conditions. On the other hand the chloride admixtures were relatively of more benefit under dry conditions.

(4) No appreciable effect on the shrinkage of the plastic concrete was noted from the use of admixtures.

(5) The increased yield of concrete containing powdered admixtures is in favor of the latter, and in many cases is probably sufficient to entirely offset the cost of the admixture. The net saving from the use of admixtures is not in cost of materials, but rather in labor cost and greater assurance of uniformity in the finished product.

(6) The voids in concrete are affected only slightly by admixtures, apparently reflecting the effect of the admixtures on the gaging water. If admixtures necessitate the use of more water for a given consistency, the voids will be increased proportionately, other conditions being the same.

(7) Powdered admixtures do not seem to prevent loss of water from concrete by evaporation under dry or partially dry curing conditions, but chloride admixtures reduce the loss under these conditions.

(8) The authors believe that the data presented herewith justify a more general consideration of the proper use of admixtures. Better and more economical concrete must result from anything that improves the plasticity or workability of the mixture, provided no deleterious effect is also involved. It has been shown that small proportions of powdered admixtures do not detract appreciably from the strength of the concrete except in the rich mixtures, where the need for and the values of such admixtures disappear. On the other hand the improvement in workability that can be brought about by the judicious use of admixtures is considerable, and this must tend to reduce costs and improve the uniformity of the finished product, under given labor conditions.

As a guide to "judicious use" of powdered admixtures, the tests indicate that the amount of an admixture to be recommended is an inverse function of the richness of the mixture. For the materials used in this investigation, the maximum percentage of celite is approximately the number of parts of coarse aggregate (relative to the cement) used in the mixture; the maximum percentage of kaolin is about twice the number of parts of the coarse aggregate, and the maximum percentage of hydrated lime is about three times this figure. For example, in a 1: 2: 4 mixture the maximum percentages of admixtures to be recommended are about 4 per cent of celite, 8 per cent of kaolin, and 12 per

cent of hydrated lime, by weight of the cement. The improvement in workability which is effected by these maximum additions is about that which should be expected from a 25 per cent increase in the cement content. Larger amounts of the admixtures than those specified above may be used in cases where the highest obtainable strength is not of prime importance.

With reference to chloride admixtures, there is no doubt that these are coming rapidly into general use, and there is no count against them, so far as we are aware, in plain concretes and mortars. Those preparations which also improve the workability of cement mixtures have an added value, over and above that of their accelerating properties.

* * *

Weighing Concrete Aggregates On Highway Pavements

By R. W. Crum
Iowa State Highway Department, Des Moines, Iowa

As a result of experience in weighing concrete aggregates upon two concrete paving contracts in 1923, the Iowa Highway Commission has adopted the actual weighing of aggregates on road pavement construction as standard practice. No startling revolution in results on these two jobs was noted, but concrete as good or better than other concrete made of the same materials was produced, and some improvement in uniformity was noted. After the next construction season, we will have much more extensive data from the construction of our 1924 program, and from cores to be cut from the work done this year.

Our experience has been entirely satisfactory thus far, and in view of the facts that: (1) the method entails no added cost, (2) no loss in time or decreased production occurs, (3) weighing is admittedly a much more accurate way of measuring granular materials than by loose volumetric measurements, and (4) that a valuable record of the amounts of materials used is secured, our only doubt is "why did we not take up this practice sooner."

Several conditions contributed to our desire to try out this method of handling aggregates. We found ourselves continually in controversy with contractors over the types of measuring boxes they wished to use, and many times we ran out of breath and used equipment which fell a long way short of our desires. We realized of course that we might improve this condition by making very rigid requirements in the specifications as to the measuring boxes, but it also occurred to us that it would also be possible to better control the mixtures by actually weighing the materials. This came the more naturally because the Iowa Highway Commission has for several years specified the proportions for paving mixtures by weight, and a part of our trouble has come from the necessity of converting our weight proportions into volumes, and the further necessity of changing mixtures due to changes in unit weight of raw materials.

We do not claim that in theory, weight measurements are any better than volumes, for if all the characteristics are known, the proportions can be specified in either way to yield the same result, but we do believe that measurements by weight will be better done and more consistently accurate.

Another important factor in the uniformity is the moisture content of the aggregates, especially in the sand. There is no doubt that variations in moisture content have a large bulking effect upon the sand and therefore a corresponding effect upon volumetric measures. Of course, if the proportions are based upon dry materials, changes in moisture will be on the safe side and the concrete will be richer, and the contractor will be out some extra cement, but the concrete, will not be uniform. I assume, however, that what we want is a uniform mixture that will not contain more cement than the contractor is led to expect. By using weights, corrections for moisture can be easily and frequently made.

We have felt that the advantages mentioned above are obvious and in the light of our experience upon actual construction, we feel that by using this system a much more favorable condition will be set up for securing uniform results than has heretofore been the case. All paving contracts on the Iowa primary road system for 1924 will be let on this basis. About 100 miles is already under contract.

Federal Commission Prepares Power Data

A SERIES of maps is now being prepared in the office of the Federal Power Commission with the idea of enabling all concerned to visualize the existing power situation and to gain an idea of the probable trends during the next fifteen years.

The basic data being used in the making of these maps are drawn from the files of the Corps of Engineers, of the U. S. Geological Survey, of the Bureau of the Census, and from the Murray superpower report. In addition, such limited data as can be secured from the states are being used. The maps cover the entire area of the New England and Middle Atlantic states, and of Virginia and West Virginia. One of them shows graphically the total annual kilowatt-hour consumption of electrified and non-electrified power. Another map shows the installed generating capacity and the water power development possible during the next fifteen years.

A third map shows the location of the generating stations, transmission lines, and substations of all the utility companies. The operating voltage of the transmission line is shown and the existing points of interconnection are emphasized. A fourth map shows the coal areas in the region and the minimum discharge of the streams large enough to furnish condenser water for large power plants in the coal regions.

Studies are being made of the records of the Bureau of the Census so that the growth of electrified and non-electrified power production in the principal regions may be charted. The curve will be extended so as to show probable power growth during the next fifteen years in Boston, New York, Pittsburgh, Philadelphia, Baltimore, Washington and Richmond. There probably will be a separate curve for the region between Buffalo and Albany.

A formula has been prepared to show the approximate cost of steam power at varying prices for coal. Costs also are being estimated for the transmission of certain blocks of power at high tension voltage. The idea is to arrive at a computation of the power produced in local steam plants as compared with that brought in as electricity. Diagrams will be prepared also to indicate the probable trends of interconnection.

While all figures are not in hand as yet, it seems probable that the cost of power at steam plants in the principal eastern cities varies from ten to twelve mills. If estimates are correct that power can be generated on the St. Lawrence for two mills, the prospect is that it can be delivered in these cities at a cost less than that of steam. It is estimated that a large block of power at high voltage can be transmitted for one mill per mile.

Concrete Paving of Tracks at Milwaukee

The progress record of concrete paving on street-car tracks at Milwaukee, Wis., in *Engineering News-Record*, Feb. 21, p. 311, was accidentally given as square yards when the figures actually represent lineal feet. Since the width of paved double-track zone is 17.2 ft. the figures already given should be multiplied by 1.9 to determine the area in square yards. This indicates approximately 570 sq.yd. per day for the company's standard concrete paving and 427½ sq.yd. when the vibrolithic finish is used. The Vibrolithic Co. states that its records show 296 to 583 sq.yd. per day, with an average of 412 sq.yd., which corresponds closely with the above figure.

Mid-Hudson Bridge to Be 1500-Ft. Suspension Span

General Features Outlined by Modjeski & Moran—Unusual Tower Design—Piers to Go 125 Ft. to Rock

REPORTING on the Hudson River highway bridge authorized by the legislature of New York State last year, Modjeski & Moran, engineers for the bridge, recommend a crossing at the foot of Church St., Poughkeepsie, with eastern approach diverging slightly northward to reach Union Square in that city. Their borings on the line of this crossing indicate that the maximum depth of rock in the middle portion of the river is about 180 ft., but that near the shore rock can be reached at depths of 120 to 130 ft. For this reason and with a view to avoiding navigation interference by river piers, their choice of bridge type is in favor of a suspension bridge of 1,500-ft. main span and 750-ft. side spans, reaching direct rock anchorages on either bank. The main span is to be flanked by a concrete approach viaduct at the east end, while the west end connects directly with the West Shore highway.

FIG. 1—UNUSUAL TOWER OUTLINE

According to the plans, the supporting members of the structure will be two main cables spaced 42 ft., each about 17½ in. in diameter, laid up of parallel wires of 0.192-in. diameter, and carried on steel towers 280 ft. high above the piers or 315 ft. above low water. The cables will be fixed to the towers and the towers fixed on their bases, and bending of the towers is relied upon to accommodate temperature and load variations. A batter leg on the outer side of each main tower post will increase the lateral stability (Fig. 3). The roadway is to be 30 ft. wide.

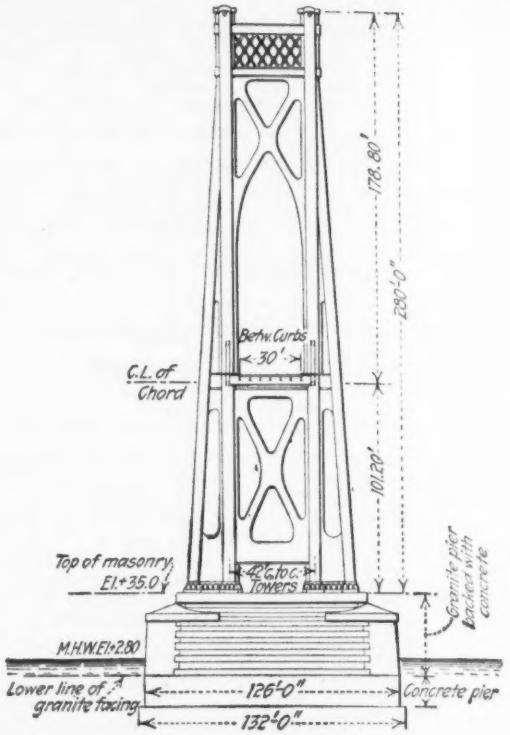


FIG. 3—ELEVATION OF TOWER

Open dredging is to be used for sinking the piers, which are to be concrete cylinders 54 x 132 ft. at the base and 35 x 126 ft. at the top.

The cost estimate for the bridge is:

Substructure	$1,800,000
Superstructure	2,867,000
East approach and anchorage	413,000
West approach and anchorage	234,000
Engineering and contingencies, 10 per cent	531,000
Total	$5,845,000

The engineers believe that the bridge can be completed within three years from the time the substructure contract is let. The enterprise is in charge of the State Department of Public Works, under Col. Frederick Stuart Greene.

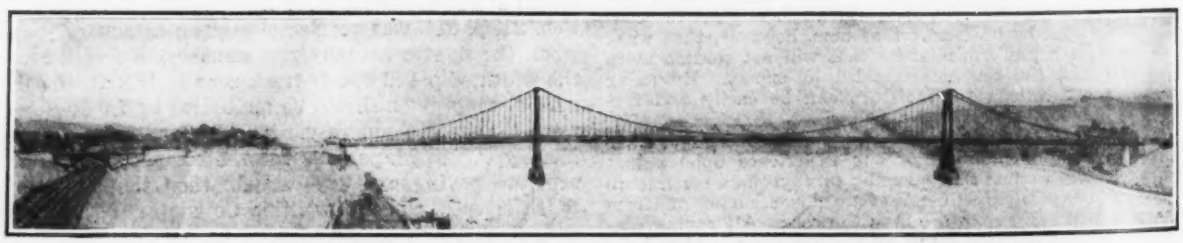


FIG. 2—SINGLE SPAN FOR MID-HUDSON BRIDGE, CHOSEN WITH REGARD TO NAVIGATION AND FOUNDATION CONDITIONS

Foul Tastes in Cleveland Water Again Caused by Phenol

Wind and Ice Carry By-Product Coke-Oven Wastes to Intake and Chloro-Phenolic Compounds Cause Bad Tastes in Water

By J. W. Ellms

Engineer Water Purification and Sewage Disposal, Cleveland, Ohio

POLLUTION of Cleveland's water supply by trade wastes containing phenol produced a water of such offensive taste on March 3 to 7, inclusive, that it caused consumers to make strong protests to the city's officials. This is by no means the first experience of this nature which the city has passed through, since complaints of a similar character have been made from time to time during the past six or seven years. Short periods of slight taste have been experienced at times during the present winter, but not to the extent or of the intensity of that which occurred during the first week in March.

Source—Investigations of the Water Department during the year 1920 definitely traced the source of this pollution of the water supply to wastes from by-product coke-oven plants located on the Cuyahoga River, about five miles distant from the mouth of the river. Wastes from these plants are discharged into the river and eventually reach Lake Erie, which is the source of the city's water supply. Under certain conditions of river flow, wind action and ice movements, the highly contaminated river water may find its way more or less directly into the city's intakes.

About 70 per cent of the city's water supply is filtered. Two pounds of chlorine per million gallons of water are applied to the filtered water before distribution. The remaining 30 per cent of the water is unfiltered, and to this portion of the supply 6 lb. of chlorine are applied to each million gallons of water. The water which is filtered and disinfected comes through a submerged intake located about four miles from the shore. The water which is unfiltered and chlorinated comes through an intake crib also located about four miles from shore and about 0.7 mile east of the submerged crib. Both intakes are a little west of north from the mouth of the Cuyahoga River, and approximately four miles distant.

The lake opposite the mouth of the Cuyahoga River has been frozen over for the past month. This ice extended out beyond the intakes, and had not moved to any extent until the afternoon of March 2. On March 1 at 4 p.m., the wind shifted to the southeast and varied from south to southeast until 9 p.m., when it changed to the southwest. From this time up to 7 p.m. of March 2, the wind blew from the southwest, when it changed to the west. Ice began to break away in large floes from the harbor entrance at the mouth of the river sometime during the afternoon of March 2, and continued moving to the north and northeast during the night of March 2 and 3.

Chloro-phenolic tastes were first noted on the morning of March 3, and grew stronger during the day. They persisted in the distribution system during March 4 to 7, although they had disappeared in parts of the system on the latter date, while still persisting in some of the outlying sections. Ice floe movements may cause a recurrence of the taste, unless the portion of the ice which is polluted moves off to the eastward and does not return to the vicinity of the intakes.

Coincident with the appearance of the foul taste in the water supply, bacterial samples showed a tremendous increase in the number of bacteria present in the intake waters. Samples from both intakes for a week or ten days had shown less than 100 bacteria per c.c., and usually less than 50 per c.c., with practically no evidence of B. coli in 10 c.c. On March 3, however, the number of bacteria increased to 10,000 to 20,000 per cubic centimeter, and with B. coli present in 0.1. c.c. These figures plainly indicate the direct nature of the pollution and also show its dangerous character.

The explanation for the sudden appearance of this foul taste seems to be that the river water is more or less continuously polluted with this particular class of trade wastes, and that special conditions permit of its carriage rather directly to the water intakes. These special conditions are: (1) An increase in the hydraulic gradient of the Cuyahoga River at flood periods, causing a more rapid flow into the lake; (2) movement of the ice formed at and near the mouth of the river to the vicinity of the intakes after it has become polluted by the contaminated water; and (3) wind and ice movements which effect a diffusion of the zone of polluted water into the purer water around the intakes. The period during which contamination of the intake waters by these phenolic wastes takes place is apparently confined to a comparatively few hours. Its contact with the chlorine used for disinfection produces chloro-phenolic compounds which are foul tasting, and which are detected in very minute amounts by consumers, because the intensity of the taste is multiplied at least 200 times, if not more, by chlorination of the phenolic bodies.

Several hundred thousand dollars have already been expended by the by-product coke-oven plants in the Cuyahoga valley, in order to prevent the discharge of phenol-bearing wastes into the river. Still more money will have to be spent by the manufacturers before these wastes cease to be a source of contamination to the city's water supply.

Status of Engineers' Licensing

Twenty-two states have registration laws affecting the practice of engineering in some degree: Seventeen which have laws covering engineering generally are: Arizona, Colorado, Florida, Indiana, Iowa, Louisiana, Michigan, Minnesota, New Jersey, New York, North Carolina, Oregon, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia. In Illinois the law covers structural engineers only; the Idaho law, civil engineering only; the Wyoming law, certain fields of civil engineering, mostly irrigation and hydraulic engineering; the California and South Dakota laws cover land surveying only. Ohio and Maryland failed to pass a law at the last meeting of the legislature. In Massachusetts one was killed and is not likely to come up again. Nebraska is said to have some kind of law regulating surveyors that apparently is not enforced. On a map from the Wisconsin Engineering Society, Washington is noted as having a law but that is in error. Missouri is questioned and so is Texas.

Educating Public Opinion as to Engineering Works

Advantages and Methods of Informing Taxpayers as to Projects—Selling Engineering Service to the Public

By Gustav H. Radebaugh
Manager, Urbana and Champaign Sanitary District, Champaign-Urbana, Ill.

A PLEASANT relationship of the taxpayer or otherwise interested citizen toward public works is recognized by many men in public life as the real essence for the public's indorsement of plans for spending money on engineering work. The old order of things dictated an attitude of secrecy. But this attitude is disappearing so fast that the engineer's steam roller loaded with a real public service program is leaving the old timer standing by the roadside and his town with its necessary construction program slipping into the discard. Civic pride and public enthusiasm lacking, this old timer abuses his fellow citizens for their lack of interest in something which he thinks (probably correctly) is of much importance to his community. The very core of our development and progress is regulated by public confidence. Review a community that has lost this asset, and you will find a people non-progressive and fault-finding in regard to everything that may be suggested for public good.

We cannot enjoy hard roads, paved streets, street lighting, storm drainage, sewerage and sewage disposal, water supply, police and fire protection, etc., without paying for them. The old argument cannot be maintained that the public should not know the real cost of these improvements. The public that knows the cost is an intelligent public and the public that does not know the cost will lose confidence in public progress. The engineering profession holds a unique position in the molding of public opinion in relation to its work. To some engineers this relationship may seem irritable and unnecessary, but if they consider public confidence worthless, their connection with the public will be of short duration.

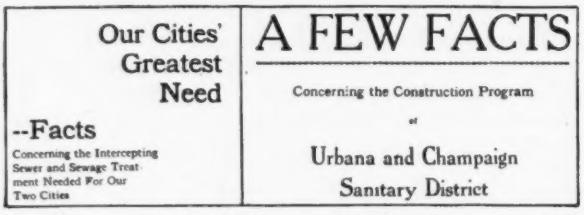

Our Cities' Greatest Need
--Facts
Concerning the Intercepting Sewer and Sewage Treatment Needed For Our Two Cities
A FEW FACTS
Concerning the Construction Program
of
Urbana and Champaign Sanitary District

FIG. 1—COVERS OF PAMPHLETS ON SEWERAGE PROJECT

Publicity Methods—Giving the people all the facts about a construction project is a problem which involves many interesting methods. No definite rule can be applied to every community, but some of the methods used by the Urbana and Champaign Sanitary District, which has a population of 40,000 and an assessed valuation of $11,250,000, will offer suggestions applicable to other engineering work.

First, we must have a purpose for the effort and money expended on the project. Many a good and just engineering project has lost the fight to gain a favorable public position because the definite purpose of the project was not clearly and firmly announced. This statement should be short but complete. One which we have used is as follows: "Purpose of the District: To relieve overloaded sanitary sewers of the two cities and prevent human filth from polluting resident basements, the Boneyard Branch, Saline Drainage Ditch and the Salt Fork." Thus in analyzing the purpose of the district we note that the sanitary sewers are overloaded, that human filth is polluting basements and that three watercourses are affected by sewage. Many cities may have conditions as bad as and worse than these, but fail to get support because of lack of proper information given to the public.

When a community or a state is receiving from the engineering profession a recommendation for a large expenditure of public funds, there should be developed an educational program, with the high ideal of public service and giving in non-technical language a complete review of the subject. The author of this copy should be careful to present just those facts that are of interest to a majority of persons. Information can be given to the public in several ways: By the newspapers, pamphlets, displays in store windows or models of projects.

Pamphlets—Pamphlets can be developed along several designs. The District issued an illustrated eight-page pamphlet 5½x8 in. entitled, "Our Cities' Greatest Need." Its cover is shown in Fig. 1. A few of the copy heads are given below.

What is done with our sewage—Rapid and unexpected growth makes new problems—Damage suit or proper sewage treatment?—Watercourses possible disease incubators—Our next public service job—What is our defense—The answer is prepared (engineer who made report)—Who are these men who prepared the answer (professional and educational record of engineers)—Why we won't go wrong—How the job is done—No guesswork about methods—Other cities busy—What will it cost—How is the money to be raised—How will the bonds be paid—What will this bond issue cost me.

Under each of these heads from 50 to 200 words of composition were used, with views showing the contaminated stream and other pictures of interest. The concluding page or clincher carried seventeen essentials on what the intercepting sewer and sewage treatment plant would mean to the two cities. A boxed statement explained that "33⅓ per cent of each $100 tax valuation on property assessed pays the interest and retires this bond issue." This pamphlet was mailed preliminary to the announcement of an election on the $500,000 bond issue, a utility's mailing list being used. The bond issue was carried by a majority of 3 to 1.

Local Newspaper Editors—"Get acquainted with your newspaper editor" should be a slogan of every engineer. The editor will be for or against your project. If engineering is service that can be merchandised he is your best customer. The editor's unfavorable attitude toward engineering work is explained in many cases because the agency introducing the project to the community has not considered it worth while to present him with a report on the contemplated work, which necessarily means the expenditure of public funds. The editor may be hard to sell. It may be that your wares are not well prepared for presentation. It may be that your recommendations for the expenditure of public funds are not well established. Confidence in your program well reported and presented to an open mind will at least secure a receptive attitude for more information.

After receiving the engineers' report on the sanitary conditions of the cities of Champaign and Urbana

the trustees of the district called on the editors of the several papers, reviewed the District's activities and presented a complete copy of the engineers' report for review. Thus the editors had all the facts. The results of the engineers' analyses were before them. If any question came up as to a detail of the report, it was simple to arrange for a conference between the editor and the author of the report, so that matters of difference could at least be discussed. What effect does this method of presentation have on the public? Many an editor has been misinformed and after an adverse declaration hesitates to retract his opposition and the project fails.

Scrap Books—A scrap book is kept by the Urbana and Champaign Sanitary District in which all newspaper clippings are filed, beginning with the first article announcing the forming of the district. This is an old and an adapted method, but is reviewed here to renew its acquaintance with the engineering profession. Every advertising student appreciates the importance of keeping records of published material. How inviting this principle is to the engineer who has the public for his clientele. In case of a dispute it is often very comfortable to be able to refer to published statements. The scrap book is also a guide when developing future copy for publication. Copy prepared for the public's perusal should be instructive and it would strengthen the author's position by having before him the material already published.

Newspaper Copy—In a project such as a sanitary district, copy should be very definitely scheduled before any material is released for publication. A suggested schedule can be developed along the following divisions of the project: A, forming of district; B, bond issue; C, construction; D, operation. Each of these divisions is a distinct problem in copy and should receive a careful analysis in relation to the others. The copy covering the forming of a district should not carry any material relative to the bond issue. Districts have failed for no other reason than trying to organize the district, vote the bonds, locate the plant and review the necessary construction work in copy that should carry only the problem of the forming of the district.

In the pamphlet noted the taxpayers were informed in regard to the importance of the project, preparing the way to the announcement of an election necessary for the passing of the bond issue. Newspaper copy to be receptive to the public should be short, simple and interesting. Newspaper publishers do not enthuse over publishing technical material that may seem simple to the engineer but is not likely to develop much interest in the public mind.

Public Opinion—Engineers many times do not consider of importance the many visitors (taxpaying visitors) who visit the job, and whose opinion is often highly respected by their neighbors and associates. It is not uncommon for an unfavorable opinion to find an important position on the desk of the consulting or supervising engineer and in some instances on the desk of the attorney. This all means delay costly to the project and irritating to the profession, which could be avoided by placing before the public information from time to time about the problems.

Another pamphlet issued by the District gives information concerning construction work, and was made accessible to visitors or other interested persons. Part of its cover is shown in Fig. 1. It is a one-sheet folder with four faced pages 5½x8 in. and gives also a popularized drawing of the sewage disposal plant. In this drawing, titles of a technical nature were held to a minimum. Some of the paragraph heads are as follows:

The work—The Imhoff tanks—The sprinkling filters—The intercepting sewer—The engineers—The cost—The district.

On the concluding page is a chronological summary listing matters of public interest, such as:

When the district was formed—The amount of the bond issue—To whom the bonds were sold and the amount received.

In the following sample paragraph the taxpayer sees that in this one section of the plant seventeen train loads or approximately 650 cars of filter stone will be

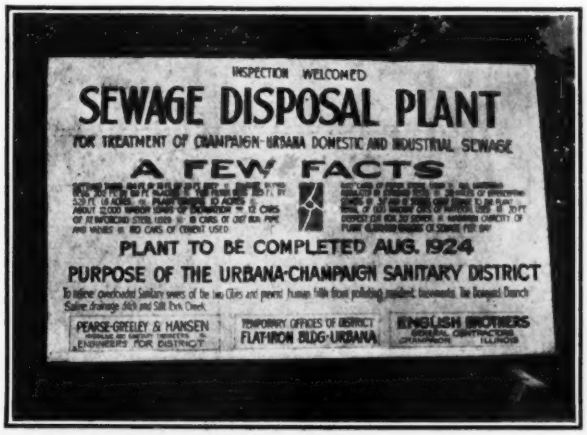


FIG. 2—SIGN INFORMS PUBLIC AS TO SEWAGE WORKS

used. It also tells him in non-technical language how the sewage is treated on this rock bed:

The sprinkling filters have an area of 1.6 acres and an average depth of filter stone of 10 ft.; 25 railway cars of cement, 6 cars of reinforcing steel, 9 cars of pipes and valves, 650 cars or approximately 17 trains of filter stone are a few of the material quantities used in the construction of this unit. The settled sewage is sprayed out through nozzles like lawn sprinklers and allowed to trickle down through the filter stone. An enormous number and a great variety of tiny plants and animals live in these rocks and busy themselves at their favorite occupation, that of acting as scavengers.

Signs on Public Works—A citizen who will take the time to visit the construction job certainly would appreciate and is entitled to information concerning the project. A prospective customer has come out to get acquainted with the work to which he is contributing his money. It is important therefore to see that a well groomed and silent salesman is always present on the job. Not costly, yet full of popular and interesting information. Fig. 2 shows a sign on the site of the District's sewage-works. Its copy is of a popular nature. This kind of information gives to the taxpaying visitor an opportunity to study the justification of the expenditure of public money and to really get acquainted with the job.

Many times opposition comes from the public for the reason that the men carrying on the work do not take the public into their confidence and are not interested in the public's desire to learn about the work. The new order of things demands attention to public interest. The people have a right to be presented with facts about the work. Public confidence is so important that any engineer who does not consider its magnitude delays not only his own progress but that of his profession.

Details of a Modern Steel Frame One-Story Shop

New Plant of Sullivan Machinery Co. Has Specially Fitted Sawtooth Roof and Crane Runways Carried by Main Columns and Jack Columns—Transfer Table Economizes Yard Space

A MAIN MANUFACTURING building which is designed to permit of extension in three directions and a yard track layout which is served by a transfer table are two notable features of the new plant of the Sullivan Machinery Co. at Michigan City, Ind. The transfer table arrangement was adopted in order to save for building purposes the land which otherwise would have been occupied by curved tracks and switches.

when the plant is working at full capacity. The Pere Marquette R.R. runs along the north side of the site. A general plan is given in Fig. 1, while Fig. 3 shows the northwest corner of the main building, with typical framing and sawtooth roof.

Structural Design—In the main building the steel framing is arranged to suit the layout of manufacturing processes and has a unit spacing of 24 and 48 ft.

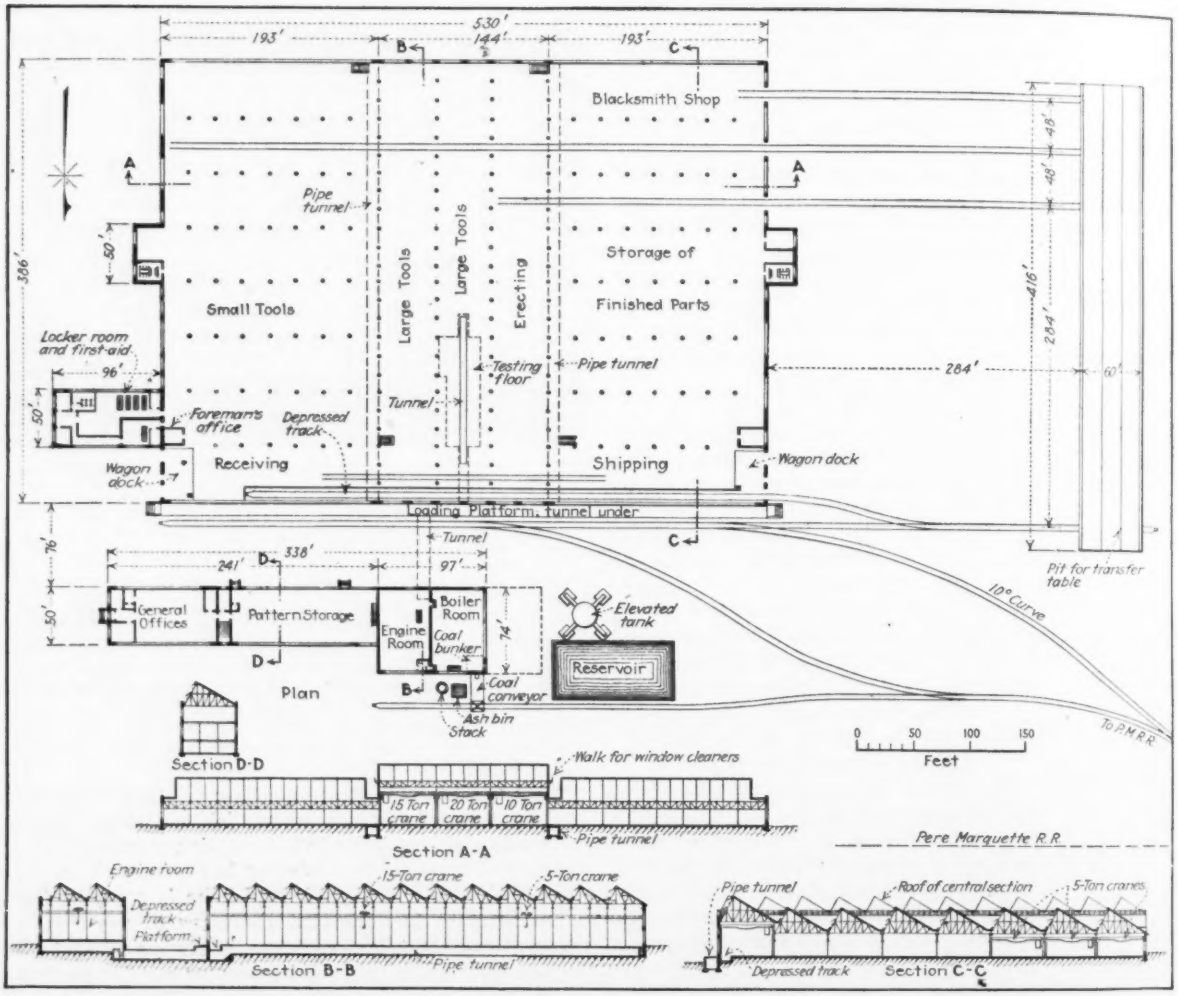


FIG. 1—NEW PLANT FOR SULLIVAN MACHINERY CO. AT MICHIGAN CITY, IND.

This plant, on a site of 125 acres, consists of three buildings of steel frame construction: (1) All manufacturing processes are combined in a main building 530x386 ft.; (2) a power house 74x97 ft. contains the boilers, electric generating plant and air compressors; (3) the third building, 50x241 ft., is a two-story and basement structure, half of which is used for pattern making and storage, while the other half contains the offices and drafting rooms, with a cafeteria and assembly room on the upper floor. An annex to the main building, 50x96 ft., contains toilet and locker rooms and a first-aid room. About 500 employees are required to fit the standard 12-ft. spacing of the sprinkler system. An exception is in the three central bays, with columns spaced 16 ft. c. to c. Four rows of columns 48 ft. apart, with a 16-ft. spacing in each row, form these three longitudinal bays, 386 ft. long, running north and south. These bays, for the larger tools and for erection purposes, have a height of 33 ft. 10 in. to the transverse roof trusses which are framed between the tops of the columns.

On each side of this central portion are eight 48-ft. transverse bays 200 ft. long, with a height of 20 ft. 5 in., except that the first or north bay, which spans a

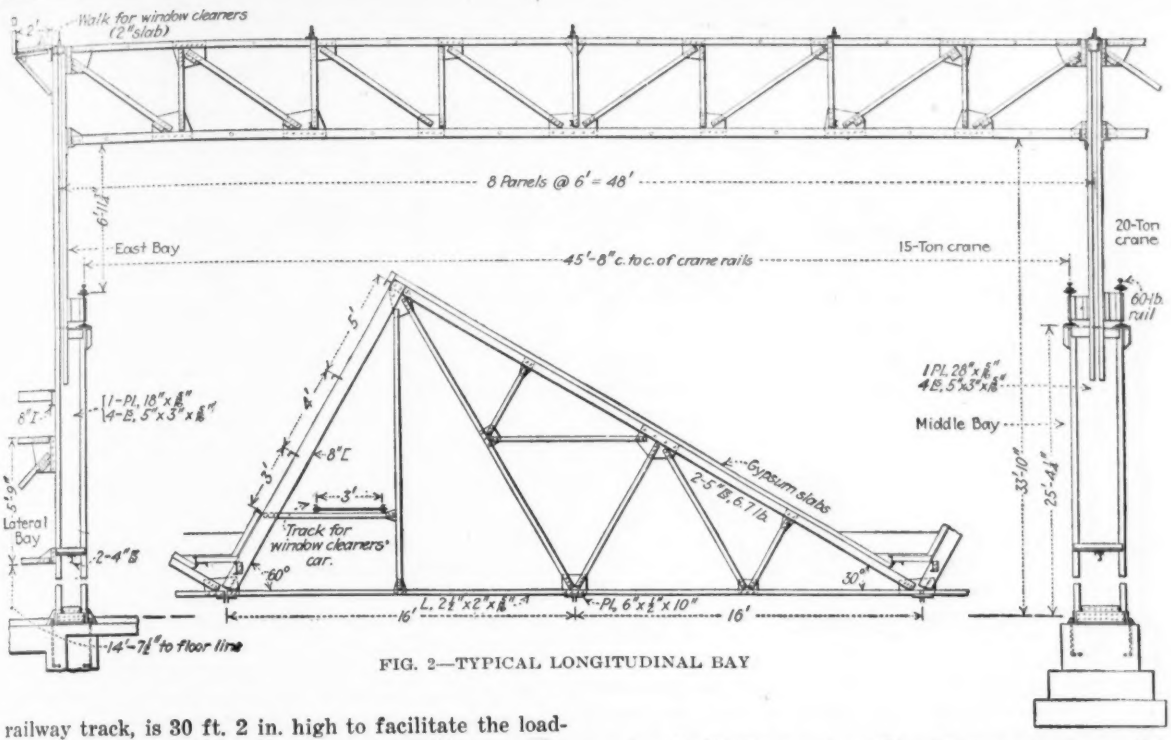


FIG. 2—TYPICAL LONGITUDINAL BAY

railway track, is 30 ft. 2 in. high to facilitate the loading and unloading of large parts and machinery. The eight transverse bays on the east side of the main part of the shop are for the smaller tools and material is received in the north bay. Seven of the transverse bays on the west side are for the blacksmith shop and storage of finished parts, while the north bay is for shipping.

With this arrangement there is opportunity for extending the building in three directions, as noted above. The north front is permanent, but the three central longitudinal bays can be extended to the south and flanked by additional side bays as required, while the side bays can be extended to the east and west.

All columns are of H-section, some consisting of H-beams and others built up of web plates and angles. In the three longitudinal bays built-up columns are used, and in these bays the runway girders for the traveling cranes are carried directly on the columns. From these main columns lighter columns of similar section extend upward above the runways, to carry the roof trusses. In all the transverse bays, the columns are single H-beams extending to the roof, and in the four bays having traveling cranes the runway girders are supported on jack columns composed of pairs of angles. These jack columns and the girders are connected to the main columns by diaphragms, while between the columns the girders of adjacent runways are connected by intermediate diaphragms.

With this method of supporting the crane girders it is practicable to introduce cranes in additional bays without affecting the structural arrangement of the building. Horizontal bracing is provided in the roof framing. Vertical diagonal bracing is provided in certain panels of the wall framing and also of the outer sides of the longitudinal bays.

Sawtooth Roof and Skylights—Although the entire roof is of the sawtooth type, the sawtooth trusses and their supports in the central portion of the building differ from those on the side portions. In the central or longitudinal bays (see Fig. 2) transverse parallel-chord trusses 16 ft. apart are framed between the tops of the columns, and upon these trusses are carried sawtooth trusses of 32-ft. span, spaced 12 ft. c. to c. In the 48-ft. transverse bays (Fig. 4) similar parallel-chord trusses are framed between the columns and carry sawtooth trusses of 48-ft. span, these also being spaced 12 ft. apart. Purlins of 5x3-in. angles along the north fronts of the sawtooth trusses form the supports for the steel sash. On the flatter south slope are 3-in. rail

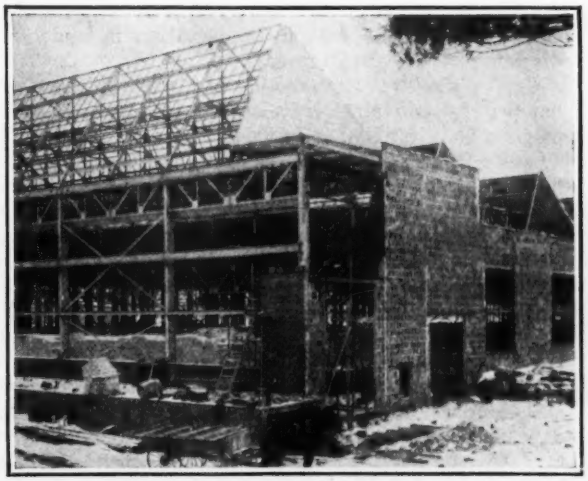


FIG. 3—STEEL FRAME SHOP BUILDING

purlins spaced 30 in. c. to c. and having 3-in. gypsum slabs filled between them. These slabs are covered with a composition roofing.

To facilitate the washing of the inside of the windows in the great area of glass in the roof, each sawtooth bay has tracks of 3-ft. gage for light trucks on which the window cleaners travel and carry their implements.

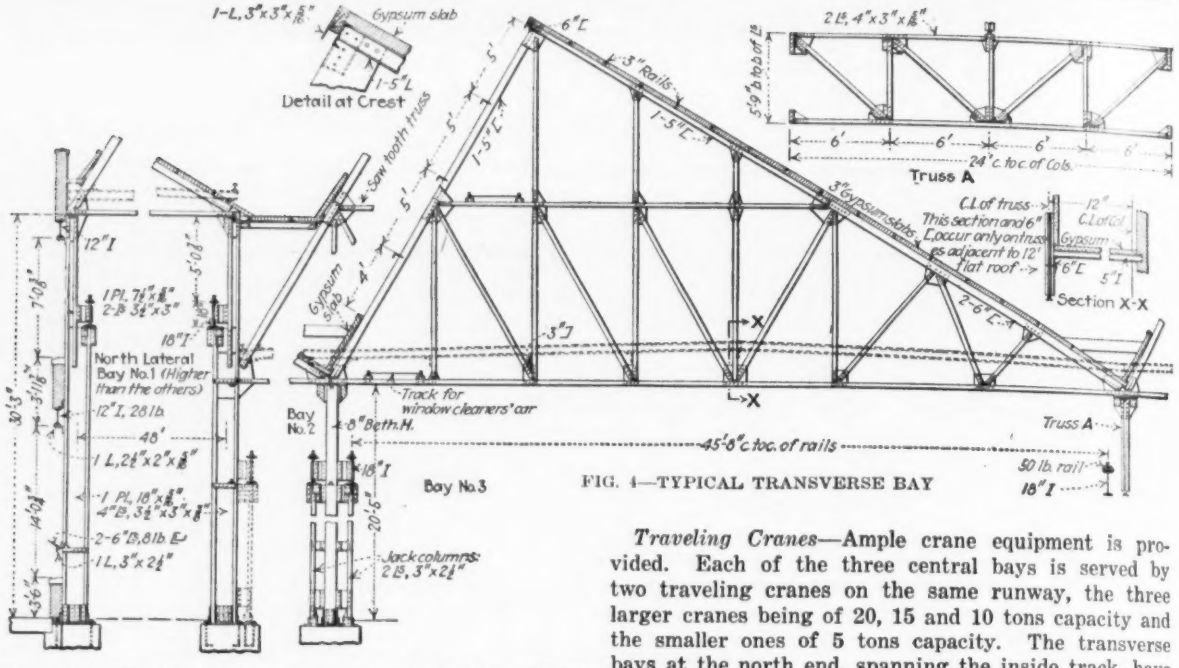


FIG. 4—TYPICAL TRANSVERSE BAY

For the outside, the cleaners can walk in the valleys of the roof, while for the glazed sides of the central portion there are outside walks, as shown. All skylights are of the Lupton steel-frame type and are glazed with factory ribbed wire glass. The top glazed panel in each 32-ft. sawtooth bay is hinged for ventilation, while in each 48-ft. bay there are two hinged panels. To ensure proper ventilation of the shop as a whole, these panels are operated from a central point instead of being operated independently and at the will of persons near them. For this purpose each line of hinged panels is connected up in lengths of 168 ft., each length operated by a driving chain from a 2-hp. motor. All the motors are controlled by push buttons aranged at a central point so that their operation is under the direction of the shop foreman.

Steel Erection—The erection of the steel frame was handled by two steel travelers or towers, carried on maple rollers on timber tracks. These travelers (Fig. 5) were 20 ft. square and 60 ft. high, each surmounted by two masts with 60-ft. booms and having a 15-hp. double-drum hoisting engine with four spools mounted at the rear end of the base or deck. Compressed air for riveting and similar construction work was furnished by a portable compressor belted to a tractor.

Walls and Doors—Horizontal lines of channels between the wall columns carry the curtain walls and steel sash. In all the buildings a large proportion of the wall area is composed of steel sash with factory ribbed glass and ventilating panels. These hinged panels are not connected up for motor operation, as in the roof panels, but are operated independently and by hand. Red brick is used for the walls of the two smaller buildings and for the north (or permanent) wall of the main building, but all other walls of the main building are of 8-in. hollow tile. Wood swinging doors are provided for the large track openings in the three temporary sides of the main building, but steel doors are used in the permanent north end. In the pattern building, the exterior doors are of steel, while tin-clad doors are used in the fire walls.

Traveling Cranes—Ample crane equipment is provided. Each of the three central bays is served by two traveling cranes on the same runway, the three larger cranes being of 20, 15 and 10 tons capacity and the smaller ones of 5 tons capacity. The transverse bays at the north end, spanning the inside track, have each a 5-ton traveling crane, while similar cranes are provided in the three rear bays on the west side. Crane runways are 18-in. I-beams, supported as explained above. For longitudinal stability of runways on jack columns there are horizontal knee braces composed of single angles attached to the columns and

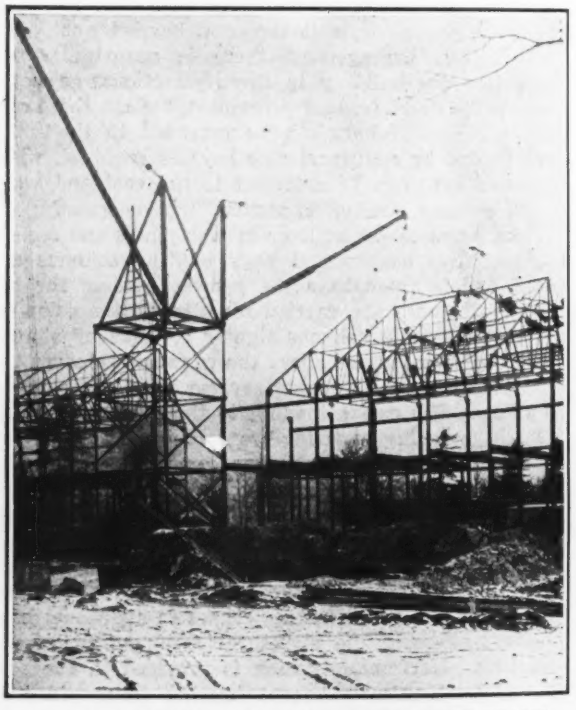


FIG. 5—TRAVELER ERECTING STEEL SHOP FRAME

runway girders by bent plates. The crane rails are of 50-lb. section, laid directly on the I-beam and secured by bent hook bolts. One end of the bolt is hooked over the flange of the girder; the other end

passes through the rail web and is secured by double nuts. Some of these details are shown in Fig. 6.

Shop Floors and Tracks—Creosoted block paving 3 in. thick on a 5-in. concrete slab is used throughout the main building, except that in the blacksmith shop concrete is used around the forges and furnaces. Tracks in the floor have concrete stringers under the rails, which are of 65-lb. Am. Soc. C. E. section, placed directly on the concrete. Gage is maintained by ¾-in. tie rods spaced 5 ft. c. to c.

Where the interior tracks cross pipe tunnels, each rail rests on a girder 11½ ft. long composed of a pair of 8-in. I-beams with top and bottom cover plates. The rails, 65 lb. per yd., are secured, as on the crane runways, by bent hook bolts. The rails and girders are embedded in the concrete roof of the tunnel, but to provide for track renewals and adjustment a pocket 1 in. long is left at each fastening. After the bolts have been tightened, they are coated with tar and the pocket is then filled with concrete, as shown.

Heat, Light and Other Equipment—All conduits for steam, compressed air and electricity are carried in a concrete tunnel from the basement of the power house to a tunnel outside the north end of the main building, the roof of the second tunnel being formed by the

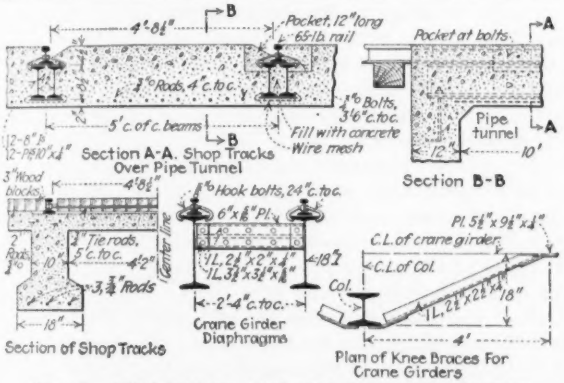


FIG. 6—SHOP FLOOR AND TRACK CONSTRUCTION

concrete loading platform. From this tunnel, two tunnels extend the full length of the outer longitudinal bays and a third tunnel extends to the testing floor in the middle bay. These tunnels are 10 ft. wide and 7 ft. high, with pipes and conduits carried by iron overhead hanger beams.

Electric current for light and power is generated at the power house, no outside source of supply being available. Water from a city main is delivered to a 75,000-gal. steel tank on a 100-ft. tower to serve the distribution and sprinkler systems. Buildings having combustible contents are equipped with sprinklers. Separate sewer systems are provided, with sanitary sewers connected to a city sewer and storm-water sewers discharging into a neighboring stream.

A concrete pond 115x50 ft. and 4 ft. deep, with spray apparatus, is provided for cooling condensing water and to supply the sprinkler pumps. Coal for the boiler room is dumped from railroad cars into a track hopper, whence it is carried by a conveyor to a crusher and then elevated to an overhead 200-ton bunker, thence distributed by a weighing larry to the hoppers of the chain grates. All this apparatus is electrically operated. Coal for yard storage is unloaded by a crane on caterpillar traction and discharged into the track hopper.

All the buildings are served by a low-pressure steam heating system, with wall radiators and overhead coils. The main lighting system, which necessarily is placed above the traveling cranes, consists of 500-watt lamps in the central shops and 300-watt lamps in the side shops, all fitted with reflectors. The lamps are so distributed that they give about 1⅔ watts per square

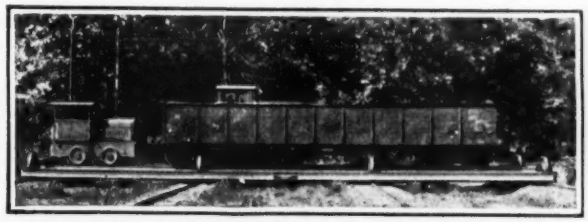


FIG. 7—TRANSFER TABLE SERVES FACTORY TRACKS

foot in the central or large machine shop and 2 watts in the small machine shop of the side bays.

Yard Tracks and Transfer Table—Track connections are provided at the west side of the plant, a spur being laid in from the Pere Marquette R.R. To reach all parts of the plant requiring car service would have involved a complicated layout with numerous switches and very sharp curves. Furthermore, such a layout would have hampered extension of the buildings toward the west. In order to reserve space for such extension, this track system was eliminated by the installation of an electrically operated transfer table in the yard, as shown by the general plan, Fig. 1. A yard lead on a 10-deg. curve connects with the loading and shipping track outside the building, and this track extends to the transfer table, which is reached by a reverse movement. This table is 60 ft. long, sufficient to hold one car and the yard locomotive, as shown in Fig. 7. It has a travel of about 400 ft.

An unusual feature is that there is no continuous pit, as will be seen from the illustration, the side walls being built only at track connections. The depth is only 13½ in. from top of table rail to base of pit rail. Eight 33-in. car wheels carry the table on four lines of rails spaced 19 ft. 4 in. c. to c., the four wheels on one side having their axles connected by a driving shaft geared to an electric motor. Current is taken from an overhead wire by a trolley pole at one corner of the table. The speed of travel is 125 ft. per minute with a 100-ton live-load or 175 ft. without load.

Yard tracks, as well as the depressed track in the north end of the building, are laid with 65-lb. rails on wood ties in sand ballast. This depressed track can be bridged by wooden gangways opposite the doors. The edge of the concrete floor on each side is recessed to receive these gangways, which are handled by the traveling cranes. Yard and shop switching is done by a 7-ton gasoline locomotive, which is shown with a car on the transfer table in Fig. 7.

Engineers and Contractors—This new plant was designed by Arthur S. Coffin, architect and industrial engineer, Chicago, who has designed most of the structures for the plants of the Sullivan Machinery Co. The Witherspoon-Englar Co., Chicago, had the general contract, while the steel work was fabricated and erected by the Kenwood Bridge Co., Chicago. The transfer table was designed and built by George P. Nichols & Brother, Chicago. This plant was put in operation in August, 1923.

Cofferdam Wrecked by Splitting of Concrete Seal

Foundation for Bridge Pier in Oregon Damaged by Remarkable Accident Attributed to Effect of Heavy Storm

By C. B. McCullough
Bridge Engineer, Oregon State Highway Commission, Salem

At 6 A.M. on Sunday, Dec. 17, the cofferdam for the main bascule pier of the highway bridge now under construction over the Lewis & Clark River, in Clatsop County, Ore., together with a portion of the foundation seal, suddenly broke loose, rising to a height of about 15 ft. and floating at this elevation until the interior became flooded, after which it sank back. The cofferdam was listed and displaced several feet laterally and twisted through a slight counter-clockwise angle.

Immediately after the accident an attempt was made to unwater the cofferdam again and float the seal out of the way. This attempt failed, owing to breakage along the sides of the cofferdam as it sank back to place. The top section of the cofferdam was therefore removed and the seal concrete broken up by shooting and taken out piece by piece. This work and the diver's report disclosed the fact that the seal (which consisted of a block of concrete 40x36 ft. and 13½ ft. thick) had separated along a nearly horizontal plane, the top half and the cofferdam rising, leaving the base of the seal together with the 200 supporting piles intact. Fig. 1 indicates the location of the break.

Construction Data—The pouring of the original seal began on Nov. 19 and continued in one unbroken operation of 41 hr. to completion. Concrete was placed under rigid inspection and with best co-operation of the contractor's construction crew. In fact, rarely has a foundation been placed under more favorable conditions. Only once was the charge in the tremie lost, and that in a center pocket, due to the tremie striking a pile.

Mixing was done with a four-sack Koehring paver, in proportions of 4:7.8:13 to 13½ by volume, to a consistency of about 5 in. slump. The materials were satisfactory, being standard cement, river sand testing better than standard, and good river gravel with oversize crushed. The river water used was also shown by laboratory tests to be satisfactory. The cement gave a strength of 503 lb. per square inch at 28 days, and concrete test cylinders cast in the field at the time of pouring gave 2,400 lb. per square inch at 28 days. The tremie used in placing the concrete was a 10-in. steel pipe. The water in which the concrete was placed had a temperature of 48 deg. F. at the time of pouring.

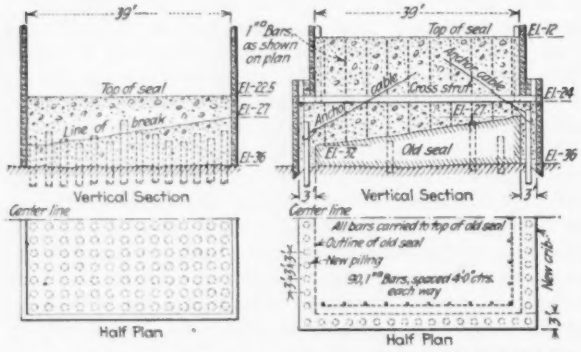


Fig. 1—Fractured seal Fig. 2—Repair of foundation

FIGS. 1-2—DAMAGED FOUNDATION AND ITS RECONSTRUCTION

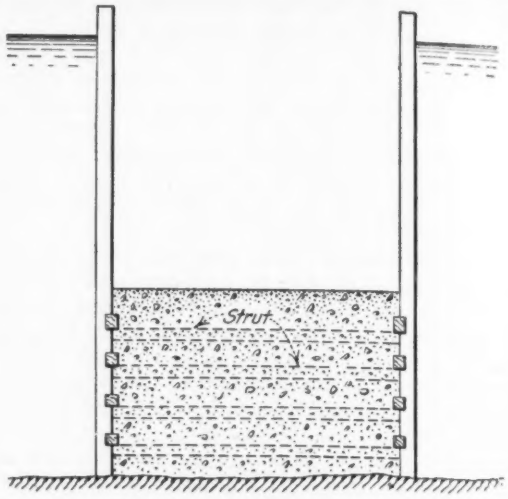


FIG. 3—ANCHORING SEAL TO CRIB TO PREVENT SPLITTING

Before pouring, a diver cleaned the pile heads and the sides of the cofferdam by jet. Material forced up between the piles by driving was removed and the bottom, a stiff, sandy clay, was left comparatively hard and clean. Tidal variations were equalized by venting the crib.

Analysis of Failure—The concrete removed appears to be excellent and very dense, with the exception of a few small areas over the lower surface, which present a slightly washed surface, they suggest that the failure was due to entrance of water into horizontal seams in the concrete, although the construction record fails to disclose any reason for the formation of such seams.

One idea which has been advanced in explanation is that the formation of the seams is due to a heavy storm that occurred on Dec. 5, when the concrete was slightly over two weeks old. This storm was accompanied by a 91-mile gale, exceptionally heavy swells and a 13-ft. tide. Perhaps the impact of these swells at the top of the cofferdam exerted racking strains on the concrete seal just above the plane of the tops of the piles. Perhaps the continuous racking of the storm opened up small seams in the comparatively green concrete and the water entering these seams leached out a certain portion of the cement and weakened the mass so that it was unable to withstand the tensile stress subsequently imposed through the unwatering of the crib. It is true that this theory seems rather far-fetched, but it is the only reasonable explanation advanced to date.

Lessons From Failure—The case brings out the necessity for precautions against tension failure of the steel along horizontal or nearly horizontal cleavage planes. The water entering such a joint exerts a hydrostatic pressure tending to lift the upper part of the concrete, which lifting tendency must be resisted by tension in the concrete, as the weight of the portion of the seal above such a plane is likely to be less than the potential uplift of the water. This tension would probably not cause rupture at once, but would act to enlarge the area slowly under the rocking action of the waves and wind applied at the top of the cofferdam, until the entire section was fractured. This is undoubtedly what happened at the Lewis & Clark River bridge. Probably

the area of the cleavage seam along the line of the subsequent break was very small at the time of the storm. The terrific impact of the ground swells enlarged this area, and each day thereafter wave and wind action exerting horizontal forces at the top of the crib operated gradually to enlarge this area.

Safeguards—One method of safeguarding against a contingency of this kind is the introduction of vertical reinforcing metal, as shown in Fig. 2, which sketches the plan of reconstruction adopted for this pier. This has the disadvantage of obstructing the crib and rendering it difficult to manipulate a tremie. Another method is by means of anchorage to the sides of the crib used in connection with weight boxes, as shown in Fig. 3. Assuming the section entirely cracked along a horizontal plane $B\ B$, and the seal thick enough to balance the hydrostatic head at the base, the uplift at $B\ B$ is $87\frac{1}{2}\ x$ lb. per square foot, where x is the distance of the plane above the bottom of the cofferdam and the total uplift is $87\frac{1}{2}\ x\ A$. In this case it is necessary to consider the tensile stresses that may be set up in the crib, and provide weight boxes sufficient to reduce these stresses to proper limits. This weighting must be in addition to that necessary to overcome the buoyancy of the crib, and if the weight boxes are to be submerged the buoyant effect on these boxes must also be considered.

Another way to safeguard against seams would be to carry the piles up to a point near the upper surface of the seal and thus utilize the tensile strength of the piling as reinforcement. This also has the objection of interfering seriously with the manipulation of the tremie and also necessitates a levelling up course above the tops of the piling deposited in the dry, which is, to a certain extent, wasteful of concrete.

Imhoff Tanks and Sprinkling Filters Being Planned for Akron

PLANS for sewage-works of 33 m.g.d. for Akron, Ohio, consisting of Imhoff tanks and sprinkling filters are being drawn locally in accordance with a report and recommendation made in 1923 by Metcalf & Eddy, consulting engineers, Boston. The engineers estimate that the population of Akron in 1935 will be 300,000. The plant will be built on land at Botzum already acquired by the city and is designed for an ultimate population of 260,000 in 1935. Recommended improvements to the existing works (also Imhoff tanks and sprinkling filters—put in operation in January, 1917) would enable the old plant to care for the sewage of a population of 40,000. The estimated cost of improvements to the old plant is about $113,000.

For the new plant, comparative cost estimates for Imhoff tanks and sprinkling filters as against an activated-sludge plant led Metcalf & Eddy to recommend the former. On the basis of treating 33 m.g.d. of sewage from a population of 260,000 in 1935, the estimated cost for Imhoff tanks and sprinkling filters was $3,614,000 and for an activated-sludge plant $3,102,000 if dewatering apparatus was included and $2,733,000 if the sludge was disposed of by lagooning instead of by dewatering. Local conditions are unfavorable to lagooning. Taking operating and capital charges into account, the yearly cost of treatment by Imhoff tanks and sprinkling filters would be $317,000 as compared with $537,000 for the activated-sludge process with dewatering, and $442,000 for this process with lagooning. The activated-sludge estimates, the Metcalf & Eddy report states, are based "upon the assumption that the fertilizing value of the activated-sludge will be so low that it cannot be marketed to yield a return sufficient to pay for the drying and incidental expenses." According to analyses given in the report, the nitrogen value of the Akron sewage is low compared with that of other cities. The cost estimates are based on an average dry-weather sewage flow of 127 gal. per capita and on a storm flow of 360 gal. A part of the city is served with separate and a part with combined sewers. The sewerage system is being extended on the assumption that by 1960 the area of the city will be 70 sq. miles and the population 550,000, delivering to the plant a maximum of 200 m.g.d. of storm-water flow. The present area of the city is about 25 sq. miles, having increased to that figure from an area of only 0.25 sq. miles in 1825.

W. F. Peters is director of public service of Akron, and J. E. Root is sewerage engineer. The plans for the new works and extensions to the old are being made under charge of Robert A. Allton, assistant engineer.

COMPARATIVE ESTIMATED FIRST COSTS AND ANNUAL CHARGES FOR (1) IMHOFF TANKS AND SPRINKLING FILTERS AND (2) ACTIVATED-SLUDGE PLANT FOR AKRON, OHIO

From Report of Metcalf & Eddy. The Estimates Are All Based on a 33-m.g.d. Plant to Serve a Population of 260,000 in 1935

IMHOFF TANK-TRICKLING FILTER PLANT

Construction Cost

Racks and grit chambers	$45,000
Imhoff tanks	574,000
Trickling filters	1,965,000
Humus tanks	182,000
Sludge-drying beds	78,000
Effluent channel	75,000
Relocated river channel	40,000
Venturi meter, diking, roads, grading and miscellaneous items	23,000
Laboratory and administration buildings	30,000
	$3,012,000
Omissions, engineering and contingencies, 20 per cent	602,000
Total	$3,614,000

Annual Charges in 1935 (Cost of construction $3,614,000)	Total Annual Cost	Annual Cost Per Capita (260,000 Persons)	Cost Per M.G. (12,050 m.g per Year)
Interest, 5%	$180,700	$0.695	$15.00
Depreciation 1.783% (30-yr. life, 4% sinking fund)	64,400	0.248	5.34
Total fixed charges	$245,100	0.943	20.34
Renewal and repair (0.365%)	13,200	0.051	1.09
Power, labor and supplies	58,600	0.225	4.87
Total operating charges	$71,800	0.276	5.96
Total charges	$316,900	$1.219	$26.30

ACTIVATED-SLUDGE PLANT

Construction Cost

Racks and grit chambers	$45,000
Fine-screen plant	156,500
Return-sludge pumping plant	30,200
Blower plant	298,200
Aeration and sedimentation tanks	1,610,000
Sludge-dewatering plant	316,300
Miscellaneous items	99,000
Laboratory and administration building	30,000
Total	$2,585,200
Engineering, omissions and contingencies, 20 per cent	517,000
	$3,102,200
Total excluding sludge dewatering plant	2,722,680

Annual Charges in 1935 (Cost of construction $3,102,200)	Total Annual Cost*	Annual Cost Per Capita (260,000 Persons)	Cost Per M.G. (12,500 m.g. Per Year)
Interest 5 per cent	$155,100	$0.597	$12.87
Depreciation 1.783 per cent (30-year 4 per cent sinking fund)	53,300	0.213	4.59
Total fixed charges	$210,000	$0.810	$17.46
Renewal and repair (2 per cent)	62,000	0.239	5.15
Power, labor and supplies	264,200	1.016	21.95
Total operating charges	$326,200	$1.255	$27.10
Total	$536,600	$2.065	$44.56

* Total annual cost with sludge lagoons = $441,500.

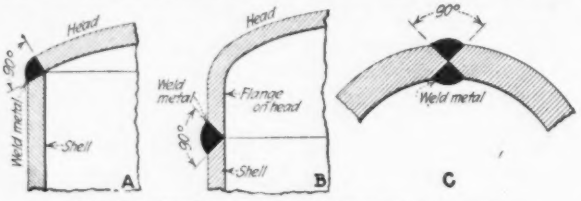
Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Proper Construction for Welds of Pressure Vessels

Sir—The letter from Arthur M. Shaw, in *Engineering News-Record*, Feb. 7, p. 252, on his experience with a welded air receiver should be brought to the attention of engineers as a solemn warning that pressure vessels fabricated as shown in his Fig. 1 are perhaps the most dangerous objects one is likely to meet. The police power of the state and of the city are the only effective protection against such criminally careless or ignorant welding. Accidents of this kind should not be used to condemn properly welded tanks.

Mr. Shaw's quotation from the A.S.M.E. code cannot be considered final, as this code is being revised and considerable attention is being paid to the possibility of using autogenous welding for pressure tanks. An acceptance test is required after completion of the tank, which undoubtedly would have caused the rejection of the tank described by Mr. Shaw. The Board of Standards and Appeals of New York City has recently approved rules for the construction of fuel oil tanks which permit welding.



HEAD WELD AND LONGITUDINAL WELD FOR PRESSURE VESSEL

An acceptance test similar to the one specified by the A.S.M.E. code is required.

If it is necessary to weld the plates at the junction of the head and shell, I believe it should be done as shown at A in the sketch herewith, not as shown in Mr. Shaw's Fig. 2. By making the opening between the edges of the plates about 90 deg. the weld metal can be fused to the base metal to the bottom of the vee. This is practically impossible, if the angle is small. Although suitable for the storage of oil and for similar purposes, tanks fabricated in this way should never be used for pressure tanks.

Technologic Paper 243 of the Bureau of Standards, "Stresses in Welded and Riveted Tanks," which can be obtained from the Superintendent of Documents, Washington, D. C., for 10 cents, shows that there are very high stresses where the shell and head meet, when a cylindrical tank is under pressure. Give the weld a chance by placing it several inches away from the head.

Heads for pressure tanks should be flanged and the weld made as shown in sketch B. Bulletin 5 of the American Welding Society, New York, gives the results of bursting tests made at the Bureau of Standards on about fifty welded tanks. These tests show good results when the heads were flanged. The efficiencies of the welds were in general higher than can be obtained from single-riveted lap joints.

If a tank is cylindrical, the stress in the longitudinal seam is twice the stress in the head seam. The longitudinal seam must therefore be well designed and carefully made, if the pressure is high enough to cause high stresses in the shell. The tests referred to above show much higher efficiencies and also much greater uniformity in strength for the tanks having the longitudinal seams welded from both inside and outside as shown in sketch C. It is probable that these double-V welds will withstand more abuse or rough handling and also have a higher fatigue resistance than the single-V welds. These points have not as yet been proven experimentally.

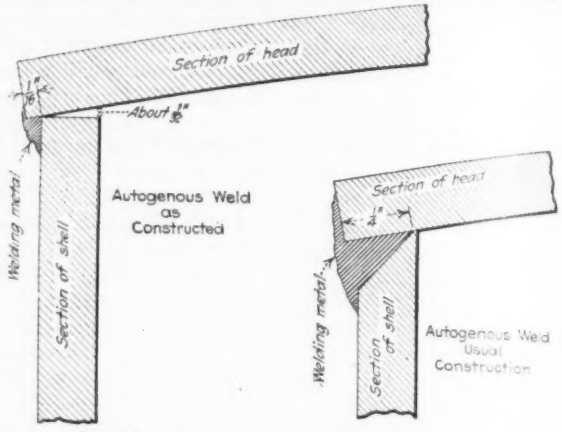


Fig. 1 Fig. 2

RIGHT AND WRONG WAY TO WELD AIR-RECEIVER HEAD TO SHELL

Reproduced from *Engineering News-Record*, Feb. 7, 1924, p. 252

If the present high cost of living is to be lowered, efforts must be made to use welding wherever it is suitable. It is not a make-shift for riveting, but a method of fabricating metals much superior to riveting.

H. L. WHITTEMORE,
Washington, Feb. 14. Bureau of Standards.

American and Norwegian Hydro-Electric Costs

Sir—Edward Svanoe, chief engineer of the A. S. Aura Co. of Sundalen, Norway, contributed an interesting article in your issue of Jan. 17, 1924, p. 106, on the proposed great hydro-electric developments near Trondhjem, Norway. Mr. Svanoe stated that the proposed plants when completed and operating under heads up to 3,000 ft. would develop power on a 76 per cent load factor that could be produced at a cost of $7 per horsepower-year for the first 100,000 hp., and that the total installation for the five plants proposed by him would be as great as 383,000 hp. Furthermore he stated that when the entire development was finished the production cost of the power would be as low as $5 per horsepower-year.

Mr. Svanoe also proceeded to make comparison between production cost of power in Norway as estimated by him at his plants, with the production cost of some California plant where he said 50,000 hp. cost $15 per horsepower-year. From this he deduced that Norwegian developments run about one-half the cost of American developments.

I take very decided exception to Mr. Svanoe's conclusion. With regard to the great plants being built under his direction, I am prepared to accept his estimates without qualification, believing they represent the last word in up-to-date developments in Norway, with labor at 31 cents per hour.

Here in western America, labor costs from 50 cents up, but our lowest-cost developments cost far less than the California case quoted by Mr. Svanoe. In Oregon and Washington we are ready to build and deliver complete hydro-electric plants from 40,000 hp. up, in convenient locations, for as low prices as will enable the developed power to be produced at about $8 per horsepower-year. I may add that this price is inclusive of all engineering construction, water rights and property, and takes into account interest, depreciation, and operation, as I presume Mr. Svanoe's figures also do. The power is on the 80 per cent load factor. All things considered, this is more favorable than Mr. Svanoe's $7 for the first 100,000 hp. at a 76 per cent load factor. This figure is not a mere engineer's guess but a serious firm's offer, based on precise data and supported by highly responsible business houses that are prepared to guarantee delivery at the prices quoted. The construction would be all masonry of high-grade type, and the machinery the latest product of our best firms.

If a comparison is to be made between Norwegian and American practice let it be between our best and their best, not between their best and our second-raters. We have the natural facilities that will enable us on this Pacific Coast to produce at as low a unit cost as anywhere in the world.

Portland, Ore., E. G. HOPSON,
Jan. 24, 1924. Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Approval by the Senate of the bill which extends federal aid for highway construction to Hawaii insures the adoption of this legislation. The measure provides that preference is to be given a system of highways best calculated to aid in the defense of the islands or which will connect seaports with the units of the national parks.

The Senate Has Passed a Bill authorizing the Secretary of the Interior, in his discretion, to defer the dates of payment of reclamation rentals and charges. This bill, if approved by the House, will extend during 1924 the authority which was in effect during 1923. The bill carries a proviso that interest is to be levied at 6 per cent on the deferred payments.

Development of 100,000 Hp. at Lachine Rapids is planned by the Montreal Power Consolidated. The Lachine Rapids Hydraulic and Land Co., a subsidiary, has been closed down for some time owing to the unsatisfactory amount of power developed, but it is understood that the parent company is preparing to completely remodel and modernize the equipment.

Applications for Appointment to one of sixteen research graduate assistantships in the engineering experiment station of the University of Illinois will be received by the director of the station until April 1, 1924. Each of these assistantships carries an annual stipend of $600 and after a two-year course the degree of Master of Science is conferred. Nominations are made by the executive staff of the station subject to the approval of the president of the university. These appointments made in the spring become effective the first day of the following September.

Apparently the Department of Justice has no intention of attempting to call to account any trade association whose only activity is the distribution of unidentified statistical information. It has been suggested that a judicial determination of a case involving such statistics only would be extremely valuable in clearing up the existing uncertainty as to the legality of such activities. The Department of Justice, however, never has taken steps against an association engaged in what always has been considered thoroughly proper statistical activities. For that reason, there has been no judicial decision covering the legality of such activities. The only way a judicial clarification of the situation can be secured would be through some process initiated by the Attorney General. This he seems disinclined to do, even with the idea of bringing a test case.

N. Y. Highways Head, Demoted, Quits

Following charges that one of the state automobiles was diverted to personal uses at a dinner-dance of departmental employees, and that there was undue fraternization with road material salesmen, Col. Frederick Stuart Greene, N. Y. Commissioner of Public Works, has demoted to their former positions as assistant engineers in the highways bureau Lowell Grossman, highway commissioner, and John H. Huber, in charge of grade-crossing elimination work. Arthur Brandt, former maintenance engineer, has been appointed by Col. Greene as Mr. Grossman's successor. The latter, who, previous to his appointment last year as highway commissioner, had been ten years in the department, will sever his connection with Col. Greene's staff and it is understood Mr. Huber will do the same. Both demoted engineers decry Col. Greene's accusations, Mr. Grossman asserting the charge and consequent demotions are "the most signal injustices." Col. Greene imputed no wrongdoing to either man's association with road material salesmen.

General Motors Plans Test Roads

A system of roadways, in which will be represented all types and conditions of roads, such as the most modern paving, good and poor country roads, hills of all descriptions, as well as roads specially prepared to determine various factors in car performance, is to be built by the General Motors Corp.

General Motors has purchased a tract of 1,075 acres in Oakland and Livingston counties, in Michigan, about four miles from Milford. This tract is about the center of a triangle, the corners of which are Lansing, Flint and Detroit, at which points, as well as at Pontiac, are located the car operations of General Motors.

The tract will be used as the testing ground for General Motors output. There will be suitable living quarters and testing facilities for the corporation's technical staff. When the development is completed practically all of road testing will be made on private property of General Motors, thus relieving public highways of work of this character.

It is believed that such work can be much more effectively and economically conducted in this manner. The concentration of effort will bring together the entire technical staff.

S.P.E.E. to Meet in Boulder, Colo.

The Society for the Promotion of Engineering Education will have its next annual meeting at Boulder, Colo., at the University of Colorado, June 25-28, 1924.

Contract Let for Bridge Between St. Paul and Minneapolis

Contract for the construction of the bridge across the Minnesota River, between Fort Snelling and Mendota, to form a new route between Minneapolis and St. Paul, has just been awarded to the Koss Construction Co., of Des Moines, Iowa, on a concrete arch design. It includes the complete construction except furnishing the reinforcing steel and the pavement surfacing. The contract total is $1,685,000. The total cost, including steel and pavement, is expected to be about $1,860,000.

The bridge is to be 4,119 ft. long and is to carry a 45-ft. roadway and two 6-ft. sidewalks. It will consist of twelve two-rib arch spans, 304 ft. long center to center, a three-quarter arch span at the Mendota end, and a short viaduct at the other. The grade rises 6 ft. to the Mendota end. The height of roadway above low water is about 120 ft. The foundations will go about 55 ft. below water. The superstructure will consist of a flat slab floor on columns. A future double-track street car line is provided for in the design.

Plans were drawn for a steel truss bridge and a concrete arch bridge as alternates. The low bid on the steel design was about $100,000 less than the low bid on the concrete design, but the county board decided to award the contract on the concrete bid. On the basis of the contract price, the complete bridge will cost $7.50 per square foot of deck area.

Besides the bridge, five miles of connecting highway will require to be built. The planning and supervision of the entire work is in the hands of Walter H. Wheeler and C. A. P. Turner Co., associated, engineers for Hennepin County for this project.

Engineering Employment Gains

Engineering positions were scarce for the first two months of the year, throughout the Central States. During the first week of the year a heavy demand existed for technical men, but for the month following up to the middle of February, engineering employment was scraping bottom, according to E. B. Miller, employment secretary, American Association of Engineers. From the middle of February to the first of March the number of engineering positions has been slowly increasing. As construction work opens up many men employed on office positions change connections and the demand for designers becomes very great. At the present time the Central States show the greatest activity in engineering work with practically no unemployment, and with an average of two positions for every competent designing engineer.

Indiana Water-Supply Men to Join A.W.W.A.

French Lick Convention Unanimously Votes to Apply for Membership In National Body

Without dissenting vote or adverse comment the Indiana Sanitary & Water Supply Association, at its seventeenth annual convention at French Lick, March 6 and 7, authorized its officers to take the necessary steps to become a section of the American Water Works Association. W. S. Cramer, past-president of the latter, indicated that for a time at least Kentucky members would probably want to be cared for by the Indiana section. Four or five years ago an adverse vote on the same question was registered because of the health officer contingent which would not care for membership in the strictly water-works organization.

Seventeen papers were presented, ranging from advertising utilities in newspapers and financing to cleaning mains and the use of dyes in bacterial culture media.

Alfred Buschmann, who runs a plumber's supply house, described the installment plan of selling plumbing fixtures in Indianapolis.

Carleton E. Davis, manager, Indianapolis Water Co., told how efficiency of water-works employees is increased by their surroundings. Descriptions were given of the Gary water-works, the Memphis well development, conditioning wells at the Indianapolis sewage-works (see *Engineering News-Record*, Dec. 27, 1923, p. 1064) and of the combined electric and water utilities at West Baden. J. O. Endris, superintendent, New Albany water-works, recounted his experience in cleaning 48-year-old mains and increasing their capacity 30 to 45 per cent.

Other Discussions

Dr. W. F. King, secretary, Indiana State Board of Health, indicated the causes leading up to the board's recent ruling prohibiting cross-connections of the public supply with an industrial surface supply. The Fort Wayne epidemic (see *Engineering News-Record*, Feb. 28, p. 348) occurred while the form of the ruling was under consideration by the board.

L. A. Guepel, director water and sewage department, Indiana State Board of Health, made a plea for better filter-plant operation. There are still towns in the state, he said, that have acquired filters but resent suggestions to have even analyses made. Some of them ran out of chlorine last year and continued to serve water of unknown content without notice to consumers. As to operators undertaking chemical and bacterial tests, the remark was made that chemists cannot easily be made out of plumbers.

An extended discussion of the use of dyes in culture media, led by H. G. Dunham, director bacteriological laboratory, Digestive Ferments Co., was largely a progress report of a committee of the American Water Works Association. The bacteriologists and chemists met apart from those interested in plant management in the immaculately clean, white-painted laboratory and works where Pluto water is bottled. L. R. Taylor, described the use of an ozone sterilization plant to prevent growths, centrifuges and cloth filters to eliminate precipitates before bottling.

Malcolm Pirnie, consulting engineer, New York, described the function of aeration in purification. With the new theories of surface reactions spraying, which increases the surface so much, is being studied and utilized to advantage in several recent installations. Experiences at Watertown, N. Y., West Palm Beach, Fla., Danville, Va., Long Beach, L. I., Poughkeepsie and Albany, N. Y., were given.

Work of the Indiana Department of Conservation was illustrated by accounts of three examples of stream pollution: A beet sugar mill at Decatur, coal mine acid at Princeton, and zinc plating discharge at Greensburg, by John C. Diggs.

The newly elected officers are: President, W. L. Younce; vice-presidents, J. O. Endris, William Luscombe, L. A. Guepel, C. J. Miller, and M. W. Miller; secretary-treasurer, C. K. Calvert; assistant secretary, C. J. Miller. Evansville made a bid for the next convention but the matter was referred to the executive committee.

Large Concrete Bridge Job Draws Only Two Bidders

Only two bids were received last week by Ramsey County and the city of St. Paul for building the new concrete bridge over the Mississippi River at Robert St. The work had been amply advertised, and six contractors had taken out sets of plans. However, the appropriation for the work was lower than the engineer's estimate of cost, and the bids in turn exceeded the estimate considerably. The work itself is considered to be a good concrete job of clean, uncomplicated design, which should have interested a large number of contractors.

A sum of $1,500,000 was appropriated for the work by the city and county. The consulting engineers, Toltz, King & Day, of St. Paul, estimated the cost of the structure as $1,617,500, including maintenance of traffic over the river during the construction of the bridge. The low bidder's price was $1,832,300 with traffic carried on a new pile bridge to be built a block away; $1,936,310 with traffic carried over the existing bridge, moved to one side on new pile piers during construction; and $1,621,310 on the basis of not maintaining traffic. These bids were submitted by the Fegles Construction Co., of Minneapolis. The other bid received was for $2,300,000.

The appropriation for the bridge is part of a $6,000,000 bond issue covering other projects, mainly the creation of an arterial highway system in St. Paul. The county commissioners and the city officials are now wrestling with the problem of whether they should add to the appropriation for the bridge and accept the low bid, or whether they should reject the bids and advertise again.

Am.Soc.C.E. Announces Spring Meeting Program

Papers on railway and power development will occupy the greater part of the open discussions at the spring meeting of the American Society of Civil Engineers, to be held April 9-12, at Atlanta, Ga. On the first day the principal paper of the morning will be on "Economics of Hydro-Electric Development," by Daniel W. Mead, professor of hydraulic and sanitary engineering, University of Wisconsin. The afternoon session will be devoted to a discussion of a paper on "The Railroads and Industrial Development of the South" by W. R. Cole, president of the Nashville, Chattanooga & St. Louis Ry. Following this technical session, there will be an excursion to points of engineering interest about Atlanta.

On the morning of April 10 there will be informal conferences of local sections and meetings of various technical divisions. In the afternoon there will be held an automobile excursion to points of scenic interest about Atlanta, including the cyclorama of the Battle of Atlanta, the Stone Mountain Memorial, etc. The trip will terminate at the East Lake Country Club for an informal dinner and social evening.

On Friday, April 11, a visit will be made to the Torrora, Mathes Lake and Tallulah Falls development and power stations of the Georgia Railway & Power Co. On Saturday, April 12, visits will be made to the Tugalo Lake development and the Yonah power development.

Announcement has been made by Secretary Dunlap that the fall meeting of the Society will be held at Detroit, Mich., Oct. 23-25.

Connecticut Engineers Meet

Leon F. Peck, of Hartford, was elected president of the Connecticut Society of Civil Engineers at its recent fortieth annual meeting held in Bridgeport. Other officers elected were Charles W. Eddy, of Waterbury, first vice-president; Harold L. Blakeslee, New Haven, second vice-president, and Clarence M. Blair, New Haven, secretary and treasurer.

About 150 delegates from all sections of the state attended the convention. Principal speakers and their subjects included James A. McElroy, city engineer, Bridgeport, "Bituminous Macadam Pavement Construction in Bridgeport"; O. H. Ammann, consulting engineer, New York City, "The Problem of Bridging the Hudson River at New York"; Harold M. Lewis, chief assistant engineer, Physical Survey, "Plan of New York and Its Environs"; Col. F. A. Snyder, "The New York Vehicular Tunnel"; H. V. Spurr, chief engineer, Purdy & Henderson Co., New York, "An Abstract on Practice in Modern Building Construction"; and Frederick J. Trinder, state director of vocational education, Hartford, "The Trade Scool Question."

Aside from reports of committees, social features and the technical discussions, there was an inspection of the steel mill of the American Tube and Stamping Co. at Bridgeport.

North Dakota Engineers Meet

Efficient utilization of lignite coal was one of the principal subjects of discussion at the joint annual meeting of the North Dakota Society of Engineers and the North Dakota chapter of the American Association of Engineers, held at Fargo, N. D., on Feb. 22 and 23. That state has about 20 per cent of the coal deposits of the country and although this is lignite, which has been considered comparatively worthless, it is now being demonstrated that with proper furnaces it is a fairly satisfactory fuel for power plants, while with the briquetting process it is said to make a domestic fuel of practically the same value as anthracite. The papers included the economic use of lignite, the equipment for strip mining of lignite and a description of the proposed Thyssen coal briquetting plant at Richardton, N. D.

Other subjects included earth road construction, the Great Lakes and St. Lawrence waterway project and the manufacture of cast iron and portland cement. There was a banquet at the Commercial Club and a visit to the water-works plant. Officers of the North Dakota Society of Engineers were elected as follows: President, E. S. Keene, dean of the State Agricultural College; vice-presidents, J. A. Jardine, Fargo, and J. A. Wallace, Bismarck; secretary, P. M. Barnes, Valley City.

Start Last Unit of Long Lake Hydro-Electric Plant

The fourth and last generator unit of the Long Lake development of the Washington Water Power Co. has been put in service. Water was turned on for the first time Feb. 10, when the generator was operated for an hour. The next day a longer run was made and the machine pronounced ready for the drying-out process, requiring a week, after which it was placed in service on the general system. This new unit is similar in capacity and general construction to the other three units installed and brings the plant up to its ultimate capacity of 90,000 hp. The 17,500-kw. generator was built by the General Electric Co. and the turbine wheel by the I. P. Morris plant of the William Cramp & Sons Ship & Engine Building Co. Water is fed into the wheel through a steel penstock 14 ft. in diameter. The generator, of the horizontal type, is direct-connected with the water wheel. At full speed the new unit will require 1,300 cu.ft. per second, delivered at a head of 171 ft. The current generated at 4,000 v. will be stepped up to 60,000 v. for the general transmission system of the Washington Water Power Co. and to 110,000 v. for the Intermountain Power Co. lines supplying the Chicago, Milwaukee & St. Paul R.R.

This new unit is primarily for reserve power and peak loads and the additional water needed in the season of low water will be drawn from the reserve supply in Long Lake. The installation was made by the engineering unit of the Washington Water Power Co.

President Addressed Concerning Muscle Shoals Lease

The Engineering Association of Nashville, Tenn., has sent a resolution to the President of the United States urging that no action be taken towards approving leases for the power at Muscle Shoals that do not conform to the requirements of the Federal Water Power Act and drawing attention to the fact that the wording of the portion of the bids applying to the manufacture of fertilizer is very ambiguous. The Association goes on record as being opposed to the bids now before Congress and suggests that before any action is taken, that the President of the United States appoint a commission of five men to be confirmed by the Senate, two or more of whom shall be hydraulic engineers, to draw up specifications under which bids may be accepted for leasing Muscle Shoals.

The McKenzie bill, embodying Henry Ford's bid for Muscle Shoals, passed the House March 10.

Lower California Soil Survey Made for Mexican Government

A survey of the soils and agricultural conditions of the Laguna Salada region of Lower California was recently made by Stanley W. Crosby, an American engineer, at the request of the Mexican government. The Laguna Salada basin is an overflow pocket of the Colorado River with an area of about 1,500 sq.mi.

After a grid of parallel lines 1.86 mi. apart had been laid out, a plane table map was made upon which were shown the topographic features of the region as well as the various kinds of soil and areas of alkali. It is stated that no map of this area had been made prior to this work.

Mr. Crosby, who is research associate in soils at the University of California, did similar work in the Imperial Valley in 1920 for the U. S. Bureau of Reclamation.

Engineering Education Study Advisers Appointed

Announcement has been made of the complete personnel of the members of the four national engineering societies appointed as advisers of the Board of Investigation and Co-ordination set up by the Society for the Promotion of Engineering Education under the grant of the Carnegie Foundation of $108,000 to study engineering education. The names are: American Society of Civil Engineers, F. C. Shenehon of Chicago and J. Waldo Smith of New York; American Society of Mechanical Engineers, John Lyle Harrington of Kansas City and F. A. Scott of Cleveland; American Institute of Electrical Engineers, Gano Dunn and F. B. Jewett both of New York; Institute of Mining and Metallurgical Engineers and the Mining and Metallurgical Society of America jointly, William Kelly of Vulcan, Mich., and Allen H. Rogers of New York. President Frank Aydelotte of Swarthmore College and Dean Carl E. Seashore of the University of Iowa have been appointed as additional members.

A.A.E. Offers Prizes for Ideal Member Specifications

Cash prizes of $25 and $10 are offered by the American Association of Engineers for the best 300-word draft of specifications for an ideal member. Anyone may compete. The award is to be on the basis of usefulness to the association and is to be made at the San Francisco convention, June 11-13, after selection by a committee headed by Prof. Charles Gilman Hyde, University of California. Drafts of the specifications must be in the home office of the association, 63 East Adams St., Chicago, not later than May 15.

Springfield Seeks Bridge Bids

The city of Springfield, Mass., will receive bids until March 25 for the construction of the North End bridge which is to replace the structure destroyed by fire last fall. There are two separate contracts, one set of bids being for the substructure, including the West Springfield approach, and the other set for the superstructure. The Springfield approach is to be put in shape by the city engineering department, which also will lay the asphalt paving. A third contract, to include extra walls, widened approaches, pylons, and stairways to the river bank, will not be advertised until after the cost of the main project has been determined. Estimates look to a cost of $100,000 or more. Specifications call for a bridge of concrete deck type with a 54-ft. roadway and two 8-ft. sidewalks.

Pennsylvania R.R. Undertakes New Work in Central Region

Improvements on which the central region of the Pennsylvania R.R. spent over $14,250,000 last year, largely in the Pittsburgh district, will require the expenditure of $8,000,000 additional to complete all of them. This sum does not include entirely new projects to be undertaken this year. The greater part of this money has been spent in the improvement of grades, the relocation of track, the building of additional track and yards, and improved engine and car repair facilities in order to expedite the movement of freight through the Pittsburgh gateway.

Major projects which are now under way in the Pittsburgh district include the track elevation and elimination of grade crossings on the north side costing $2,350,000, to be completed in April; grade-crossing elimination and relocation of track near New Brighton, Pa., costing $3,530,000, and to be completed in 1925; engine house and facilities at Sharpsburg, costing $1,000,000, to be completed in July; expansion to the four-track system at Sharpsburg which will be completed in April; new engine facilities at Conemaugh, Pa.; and numerous smaller projects which are well under way.

Under the new arrangement considerable traffic will be diverted from the main line, from Pittsburgh eastward, and will move instead along the north bank of the Allegheny River to Kiskiminetas Junction, thence to Conpitt Junction, near Johnstown, where it will come back on the same line for haul over the mountains.

Board Reports on Detroit's Water Supply Needs

Consulting Engineers Recommend Immediate Development of 300 M.G.D. New Supply

A commission of consulting engineers consisting of George H. Fenkell, William C. Hoad, Clarence W. Hubbell, Theodore A. Leisen and Gardner S. Williams, appointed by the Board of Water Commissioners for the City of Detroit to consider jointly the reports on additional water supply for the Detroit Water system, has submitted its report. Recommendations include the immediate development of a new supply of 300 m.g.d., to be taken from the American channel of the Detroit River at the head of Belle Isle, thence to be carried by gravity tunnels through the city, at first to one, and finally to two new distributing stations, one situated in the western and one in the northeastern section of the city, there to be filtered and delivered into the street mains.

Further recommendations include certain alterations at the present Jefferson Ave. station to bring its output up to the maximum point consistent with economical and effective operation.

Immediate Action Urged

Immediate action by the Board of Water Commissioners is recommended by the commission to carry out the program outlined in order that the city may be saved from a probable serious water shortage in 1929. A definite program of construction is submitted as part of the engineers report, which provides for improving the Jefferson Ave. station and its distribution system immediately; for getting the new distributing station in the western part of the city into operation by 1929 and for the construction of the northeastern station whenever needed.

Among the fundamentals which the engineers mention, which should be taken into consideration in the design and construction of the various structures required for the contemplated additional supply are:

(a) An estimated population of 3,400,000 people residing within an area of about 300 sq.mi. including the present city limits at some time between 1950 and 1960, who will be dependent upon the Detroit water-works. The average daily requirement is estimated at 520 m.g.d., of which 220 m.g.d. will be required in a central area supplied from the present Jefferson Ave. station 180 m.g.d. in a western area and 120 m.g.d. in a northeastern area, with the maximum daily requirement of 30 per cent and a maximum hourly requirement of 60 per cent greater than the average.

(b) The Detroit River is considered the most available source and a location near the present intake crib in the North or American Channel near the head of Belle Isle the most satisfactory place for obtaining the water needed for the additional supply.

(c) Water taken from this source or elsewhere in the Detroit or St. Clair Rivers or in Lake St. Clair, should be purified by a filtration process.

(d) The most pressing demands for additional supply will first come from a territory to the westward of West Grand Boulevard to be taken care of from a distribution station referred to as the Springwells station. At a somewhat later time it will be desirable to establish a center of distribution at a station designated as the Northeast station.

(e) Only raw water should be distributed through masonry tunnels, thus necessitating the location of a purification plant at each distributing center.

(f) Unless prohibited by governing conditions or excessive expense, the water should be transmitted from the river to the distributing centers in tunnels by gravity.

(g) A storage of filtered water should be provided at the Springwells and Northeast stations of at least 42 and 28 m.g.d. capacity, respectively.

(h) The main tunnel from the intake to the proposed point of division in the vicinity of Pennsylvania and Forest Avenues, should be 14-ft. in internal diameter; the branch tunnel supplying the Springwells station should be 12-ft. in internal diameter, and the branch tunnel supplying the Northeast station should be 10-ft. in internal diameter.

(i) The new intake tunnel should be cross-connected to the present intake tunnel at the Jefferson Ave. station.

(j) The new intake system should be of sufficient capacity to supply in emergency the entire needs of the city on the maximum day, estimated at 740 m.g.d., when the water surface in the Detroit River is at Elevation 88.

(k) Engines 1 and 2 at the Jefferson Ave. station should be immediately replaced by motor-driven centrifugal pumps of 140 m.g.d. combined capacity.

(l) The addition of the pumps recommended and certain force mains with their appurtenances, will enable the present system to utilize its entire capacity of 350 m.g.d. and to carry the load of the city until 1929, at which time the Springwells station must be ready for service.

The estimated cost of the improvements recommended is $33,584,000.

Tunnel Assessment District Plan Wins in Supreme Court

A decision rendered by the U. S. Supreme Court March 3 upholds the local-assessment plan of paying for the Second St. tunnel in Los Angeles. By this decision the District Court was directed to dismiss the suit of Willard H. Stimson and other property owners to restrain the city from collecting an assessment for the tunnel. It is held that no Federal questions are involved.

This decision marks the end of the fight of property owners of Los Angeles against construction of the highway tunnel driven through the hill on the line of Second St. The property owners resisted the assessments to pay for the improvement on the ground that the tunnel is primarily for the benefit of the state highway to San Francisco, which enters Los Angeles along Second St., and hence is not a local improvement subject to the state law on assessments. They sought an injunction in the federal district court, which was denied, and then appealed.

Random Lines

Sir—In T. O'Conor Sloane's "Rapid Arithmetic," which has recently received much favorable comment, this occurs on page 158:

"Another rhyme by which to remember the value of 'pi,' carried out to the twelfth decimal place is the following; as before, the number of letters in each word gives the corresponding digit.

3 1 4 1 5 9
See I have a rhyme assisting
2 6 6 3 5 9
My feeble brains its tasks some-
9
times resisting.

"The mathematical value is better than the grammatical."

We question the accuracy of this last statement as, according to our computation, the score stands:

Mathematical errors, 2
Grammatical errors, 1

And in your category of "bizarre engineers" have you noted these?

1. In Sweet's Engineering Catalogue, 1923, p. 633: "A prominent **hospitalization engineer** recently stated he did not know of any first class hospital," etc.

2. A recent circular advertising air filters begins with the announcement: "**Dust engineering** is a comparatively new branch of applied science."

3. Edward J. O'Brien, in the introduction to "The Best Short Stories of 1923," in speaking satirically of the trend toward standardization of short stories says: "If durability is merely a matter of structure, let us offer a great reward to our **short story engineers.**"

The latter quotation suggests that porch climbers might lay claim to the title of **second story engineers.**

H. M. H.

Engineering Societies

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Sixteenth Conference, Los Angeles, Calif., April 7-10, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Atlanta, Ga., April 9-12, 1924.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Convention, June 18-20, Pasadena, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

The Providence, R. I., Engineering Society will hold a joint meeting March 18 with the Providence Section of the American Society of Civil Engineers, subject: "Cleaning Up the Public Waters of Rhode Island."

The New York Section of the American Society of Civil Engineers will meet on March 19 jointly with the New York and Metropolitan Sections of the A.S.M.E., A.I.M. & M.E. and A.I.E.E. The speakers will be Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, New York City; Julius H. Cohen, counsel of the Port of New York Authority; and Robert J. Cary, general counsel of the New York Central Railroad Co.

The Idaho Chapter of the American Association of Engineers held its annual convention at Pocatello in January, and the society note in these columns Feb. 14 should have so stated instead of naming the Idaho section of the American Society of Civil Engineers.

Personal Notes

FRANK H. MARTIN, since 1921 chief engineer for the Manitoba Power Co. at Winnipeg, has opened a consulting engineer's office at Winnipeg; he is retained in an advisory capacity by the Manitoba Power Co. Mr. Martin has been identified with hydro-electric developments of the Electrical Development Co., of Ontario, the Winnipeg General Power Co., the Mexican Light & Power Co., the São Paulo and Sapacia plants of the Brazilian Co., the Rio de Janeiro Tramway, Light & Power Co., the Toronto Power Co. at Niagara Falls, Ont., and the Ontario Power Co. at Niagara Falls. He first went to Winnipeg in 1914 as designing engineer for the Winnipeg River Power Co., and from 1916 to 1919 was chief engineer for Willis L. Adams at Niagara Falls, N. Y.

MILTON H. BRONSDON, Providence, R. I., city engineer and deputy commissioner of public works, has been made commissioner of public works to succeed WALTER E. SLADE. Mr. Brondson took over his new responsibilities March 1. Mr. Slade has been in the employ of the city of Providence for more than 50 years.

H. T. JENKIN, formerly assistant superintendent with the J. G. White Engineering Corporation on the Jackson Heights development on Long Island, has gone to Ann Arbor, Mich., where he has become construction superintendent of the new hospital being erected by the University of Michigan.

J. WARREN SMITH, for a number of years with the American Bridge Co., and lately with the Dominion Bridge Co. as chief engineer of their Toronto plant and still more recently designing engineer for the Toronto Transportation Commission, has been appointed manager of the London Bridge Works of London, Ont.

GAYLORD C. CUMMIN, until recently associated with the Institute for Public Service of New York City, has established an independent office as civic consultant. Mr. Cummin will specialize in the New England field. His present address is 10 Wood Street, Concord, Mass., and it is expected that a Boston office will be opened shortly.

J. M. RUTHRAUFF has been appointed county engineer of Yuma County, Arizona, succeeding Nelson Davenport, who resigned. Mr. Ruthrauff was formerly city engineer of Tucson, Ariz., having served three terms in that position.

V. H. HENDERSON, assistant county engineer of Hidalgo County, Texas, has been appointed county engineer of Star County, Texas.

A. P. DAVIS has accepted an invitation to deliver a series of lectures on hydraulics before classes at the Sheffield Scientific School. These lectures will be along the same lines as those presented by Mr. Davis at Yale two years ago.

W. N. HARRIS, recently division state highway engineer at Wichita Falls has been appointed county engineer of Denton County at Denton. He succeeds H. T. Brewster who becomes engineer of materials and tests of the state highway department.

WILLIAM A. STICKEL has been given the appointment of supervisor of roads, Essex County, N. J., by the Essex County Board of Chosen Freeholders. He is also retained as county engineer. He takes over the work of George W. Eager, who retires after 15 years of service. Fred L. Baldwin, superintendent of bridges and culverts, becomes superintendent of maintenance under Mr. Stickel.

Obituary

WALTER J. FRANCIS, consulting engineer of Montreal, and president of the Engineering Institute of Canada, died suddenly at Montreal March 6. He had been in his usual good health and attending to business until about an hour before his death. He was 45 years of age. Mr. Francis graduated in civil engineering at the University of Toronto and was engaged in several important construction works including the Toronto Union Station, the hydraulic lift-locks of the Trent Canal and the canal construction. He was awarded the Gzowski medal in 1906 by the Canadian Society of Civil Engineers for a paper describing two hydraulic lift-locks. He carried out much hydro-electric work on dams in Quebec and Western Canada. Mr. Francis had been elected president of the Engineering Institute of Canada Jan. 22, 1924, having served out most of the 1923 term as president upon the death in March of A. St. Laurent, elected in January 1923. J. B. Challies, senior vice-president of the Institute, will probably succeed Mr. Francis.

WILLIAM BRADLEY, president of Bradley Contracting Co. until 1918, died Feb. 20 at his home in New York City. In 1900 when the first New York City subway contract was let, Mr. Bradley was given a subcontract on excavation of the upper Broadway section from 60th to 104th Sts.; later his company did work on two sections of the 4th Ave. subway in Brooklyn and the Delancey St. subway. The company also constructed the concrete flooring in the Jerome Park reservoir, the portion of the Catskill aqueduct under Croton Lake and the Jersey City tunnel of the Pennsylvania R.R.

STANLEY D. PUGH, civil engineer, Columbus, Ohio, died recently in that city after a brief illness, at the age of 49 years. Mr. Pugh had been a promoter of the plan for a belt line railway for the city of Columbus, and only about a month ago that project was favorably acted upon.

FREDERIC I. WINSLOW, Framingham, Mass., an engineer of the Water Division of the Metropolitan District Commission, Boston, and treasurer of the New England Water Works Association, died at his home in Framingham recently; he was 61 years of age. Mr. Winslow was born in New Bedford, Mass. After a four-year course at the South Boston School of Art, he began a period of over forty years' service for the city of Boston and the Boston Metropolitan District Commission. From 1881 to 1883 he was in the Boston city surveyor's office. From the latter date until 1918 he was connected with the Boston water-works, mostly on construction work until 1904 and thereafter largely on design. During the World War, he was granted leave of absence from the city of Boston and served as first assistant engineer to the resident engineer of the U. S emergency destroyer plant at Squantum, Mass.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Increase in Winter Buying of Cast-Iron Pipe

On 42,000 Tons Ordered From One Maker Direct Savings of $2 a Ton Were Made—Other Indirect Advantages Cited

By Ralph R. Silver
American Cast Iron Pipe Co., Birmingham, Ala.

THE winter buying program started by the American Cast Iron Pipe Co. in 1922 is meeting with success. Never before has as much cast-iron pipe been booked for winter manufacture and shipment by this company as during the winters of 1922-23 and 1923-24, but in stating that the campaign is a success the interests of the cast-iron pipe user, as well as those of the manufacturer, have been considered.

The winter buying movement, from the beginning, has been primarily a movement of co-operation. It was a case where both the maker and user of cast-iron pipe anticipated mutual benefits if both conducted their affairs with the best interests of the other in mind. There is just as much evidence that the best interests of the pipe user have been served and that he considers the program a success, as there is that the manufacturer has been benefited.

Program Benefits Many

While other pipe makers may not have taken up this winter buying movement as extensively as the American Cast Iron Pipe Co., many of them have participated in the program to some extent. There is reason to believe that the result, as shown by the business of the American company, could conservatively be tripled or quadrupled in comparing the winter buying movement in the industry as a whole with the cast-iron industry as of old. As the present writer is familiar only with the details of this movement in its connection with the American Cast Iron Pipe Co., specific figures of the winter buying movement must be confined to this corporation:

In December, January, February and March of the current winter approximately 42,000 tons of cast-iron pipe have been specified for manufacture and shipment by pipe users to whom the logic of the winter buying movement had appealed and by whom the price concessions made by the American company were recognized as genuine. Any computation of the actual saving in dollars and cents thus realized by cast-iron pipe users is, at best, only an approximation and liable to mis represent the real facts in the case.

Winter Prices Lower

For example, during the current winter, for business that did not come under the head of winter buying, the open market quotation for cast-iron pipe f.o.b. foundry Birmingham, Ala., has approximated $47 to $48 per ton. The price at which winter business was booked has averaged about $45 per ton —a concession by the manufacturer of $2 to $3 per ton. Therefore, it might be stated on superficial consideration that this winter the customers had saved $2 per ton on 42,000 tons, or $84,000.

While this is the truth, it is apparent that it may not be the whole truth. The saving has been this much, but the probabilities are that it has been more, because there is no way to determine what the pipe market would have been during these three months if none of the pipe manufacturers had offered these price concessions for winter orders. And again, there is no way to determine the actual price per ton for these 42,000 tons of pipe if the order should be placed this spring or summer as compared with the winter. Had it not been for this winter buying, the price of pipe this summer probably would be on an entirely different basis than the one which will exist. This latter statement is understood only by those familiar enough with the operating department of a large manufacturing plant to realize the effect produced on production costs by ability to keep a full working force together and the plant in full operation on account of this winter business.

Intangible Values Involved

From this it is seen that the intangible values involved in the winter buying movement are such that it is probable the full benefit of the movement can never be reduced to cold facts and figures. The tangible benefits to the user of cast-iron pipe whose winter buying orders have been placed with one manufacturer, however, are thus seen to approximate between $80,000 and $90,000 in one winter. The intangible benefits accruing to the pipe user are that he is in better shape to start his construction work for the summer than he has ever been before. The mere fact that he has placed his order for pipe means that he probably has perfected the majority of his construction plans and specifications for the year and that he is "all set" for a more efficient and better quality of construction work this year. The probability of delayed delivery of material, for him, does not exist and his full time and energy can be devoted to the problems of the actual construction job under way.

For the pipe manufacturer there are no tagnible values to the winter buying movement. All of his benefits are speculative, but they nevertheless are so real that the manufacturer feels as sure of the benefits of winter buying as if he could point to a column of figures on the profit side of his ledger. The intangible values are several, but the first that appeals to the pipe manufacturer is the benefit of keeping his organization together, operating his plant full time, and thereby holding to normal his cost of production.

Stabilizing Production

The elusive will o' the wisp that haunts the dreams of every operating executive is called Cost of Production. For reasons unknown it goes up one month and comes down the next. One thing, however, the manufacturer has learned from experience. It is that the volume of production and the cost of production, other things being equal, move inversely. When volume of production comes down, the overhead cost of a large manufacturing organization must be proportioned over a less number of production units. Therefore, the big thing the manufacturer realizes out of winter buying is that it enables him to maintain his volume of production and the benefits he realizes in keeping down his cost of production, he considers it only fair to pass on to the customer whose co-operation helped him.

Following this line of reasoning to its logical conclusion, the deduction can only be reached that this form of co-operation between the user and maker of a product will result in the average production cost of the product for any period of years being less than it otherwise would have been. If this decrease in production cost is shared between the producer and consumer the savings made by either in time, money and trouble is very real and very great. What that saving is, however, can never be determined other than by speculation, because there would never be any way to know what conditions would have obtained if this co-operation between the producer and consumer had not existed.

Winter Deliveries on Job Site

One element of confusion has entered into consideration of these matters: Winter buying is not synonymous with winter work. They can be and in many cases are closely related, but it does not necessarily follow that such must be the case. In the northern latitudes it yet remains to be shown that there is real economy in winter construction work. The handicap from cold weather and frozen ground in some cases is serious. It is a significant fact, however, that some of the most enthusiastic winter buying customers of the American Cast Iron Pipe Co. are located in the northern and northwestern states. Some of these customers do winter construction work, others of them simply order their pipe requirements and either store the material or make use of sleds on the snow-covered ground in distributing the pipe along the proposed trench. Instances have been called to our attention where this latter method has been successfully used to distribute pipe over ground that would make transportation very difficult after the frost had gone. The point to be

Contractors May Join in Defense Against Concrete Roller Patents

Efforts are being made by Brig.-Gen. R. C. Marshall, Jr., general manager of the Associated General Contractors, to interest road contractors in creating a fund to defend one of the several suits pending against users of the Macon type concrete roller for alleged infringment of patent. All road builders have a common interest in these cases, Gen. Marshall and the other officers of the A.G.C. believe, and therefore should bear part of the burden of making a thorough test of some case.

The patentee has won a decision in the District Court at Atlanta which has been sustained by the Circuit Court of Appeals. The issue cannot be carried before the United States Supreme Court until a contractor wins, in some other district court and another Circuit Court of Appeals, a contrary decision. The Portland Cement Association assisted in the defense of the case won by the patentee in Atlanta.

The patent involved was issued in 1914, but suits for infringement were not started until about two years ago. The patent covers the principle of rolling concrete with light hand-rollers.

Bills Propose Transfer of War Equipment to States

Bills have been introduced into the House and Senate providing for the transfer from the War Department to various states for road-building uses $32,500,000 worth of tractors, trucks and other army equipment. The tractors, most of them new, are held in storage at various army posts. They comprise 3,200 5-ton and 800 10-ton machines. The motor trucks in storage which the bills would transfer to the states total 5,000 machines.

According to the bill California, Illinois, Missouri, New York, Ohio, Pennsylvania and Texas would each receive more than $1,000,000 worth of equipment.

(*Concluded from p.* 468)

remembered is that winter buying and shipment of cast iron pipe may be well considered beneficial to the pipe user even though he may not care to undertake the installation of the material until the following spring or summer.

The user and the maker of cast-iron pipe can gain a better perspective of this movement if they will stop to consider that it is confined by no means to pipe making or to pipe line construction. Within the last two years winter buying and winter construction have been much talked of in many different lines. Government officials including Secretary of Commerce Hoover and Franklin D. Roosevelt have enthusiastically endorsed it and urged its benefits in every phase of construction activities. It is a far bigger thing than the cast-iron pipe business or the water works and gas works business. Men have simply come to realize the waste involved in seasonal business activity. They are bending their efforts to make industry and construction as near as possible an all-year undertaking.

Business Notes

ARTLEY PRODUCTS CO., New Market, N. J., dealers in asphaltic coatings, paints, waterproofing and roofing materials, changed its name Jan. 1 to the Pure Asphalt Products Co. The adoption of the new name involves no change in personnel or policies.

HYMAN MICHAELS CO., Chicago, dealer in new and relaying rails, has placed Al Michaels, assistant treasurer, in charge of its Pittsburgh office located in the First National Bank Building.

NATIONAL STEEL FABRIC CO., Pittsburgh, manufacturer of wire mesh reinforcement for concrete roads, buildings and other structures, announces the appointment of Augustus W. Rogers as district representative at Rochester, N. Y.

GRAVER CORPORATION, East Chicago, Ind., manufacturer of tanks, water softeners, filters and general steel plate construction, has appointed L. W. Welling as manager of its Eastern office in the Grand Central Terminal Building, New York.

PAWLING & HARNISCHFEGER CO., Milwaukee, manufacturer of excavators, cranes and machine tools, has opened new offices in the South. N. B. Norris, formerly district manager at New Orleans, is now district manager at Memphis. D. J. Murphy, formerly at the New Orleans office, is now district manager for Texas, with headquarters at Dallas. F. W. Truex continues as district manager at Atlanta. W. J. Dugan, as Southern sales manager, will have charge of the entire Southern territory, with headquarters in Memphis. A complete stock of excavator renewal parts will be maintained at the company's Memphis plant.

Equipment and Materials

Standard Loader Handles Snow

Following the storm of Feb. 20-21 in New York City, C. J. Mallett, Inc., of the Bronx, took a contract for removing snow which had been piled along the curb to a height of 5 ft. and a width of 10 ft. This piled snow was loaded into motor trucks with a standard model 24 gasoline-driven Haiss

creeper loader and hauled to a dumping point along the waterfront.

With the mechanical loader and a crew of one operator and two shovelers cleaning up outside the feeding propellers of the machine the contractor was able to load from 6½ to 7 cu.yd. of snow in from 3 to 4 min. The loader used was a stock machine designed for hauling sand, gravel and stone. No changes were made to adapt it to snow removal work.

Pull Shovel Designed for Deep Trench Excavation

For deep trench excavation a modified form of steam shovel in which the dipper digs toward instead of away from the machine, thereby eliminating the necessity of straddling the trench,

is the latest addition to the line of equipment manufactured by the Northwest Engineering Co., Chicago. For this excavator, called the trench-pull shovel, the makers claim the combined advantages of the dragline, in resting on solid ground and backing away from its work, and of the steam shovel in its digging power and capacity.

The equipment is mounted on crawler treads and is powered by a gasoline motor supplied in two sizes, a 70-hp. engine for handling dippers from 42 to 48 in. wide and a 60-hp. engine for dippers up to 39 in. wide. With dipper arm hinged at the end of the boom the machine has a long reach and is capable of digging trenches 16 ft. deep. By a change of booms the outfit can be converted into a dragline, thus offering the contractor equipment capable of handling practically any kind of drainage or sewer work. The machine, the manufacturers point out, can load itself on a standard flat car under its own power and may be shipped without dismantling.

World's Largest Saws Shipped

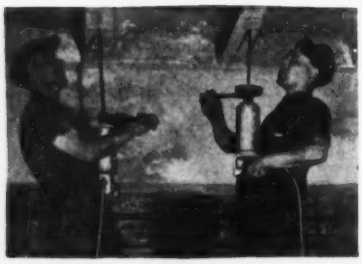
Two circular saws, each 108 in. in diameter, have just been completed by Henry Disston & Sons, Inc., and shipped from Philadelphia to the Eureka Lumber Manufacturing Co., Hoquiam, Wash. These saws are exact duplicates of two Disston cut-off saws installed in the same mill in April, 1920, and are the largest saws in the world. They are used for cutting giant cedar logs into shingle bolts.

Each saw was made from a steel ingot weighing 1,140 lb. This ingot was reheated, rolled and trimmed until the weight of the finished saw was

795 lb. The teeth are inserted in the blade, 190 being required for each saw. They are of the spiral tooth type, a Disston invention, being inserted in the blade on spiral lines to insure smooth cutting and give them full clearance without the necessity of setting them. They are sharpened by automatic machinery.

A New 9-Lb. Electric Hammer

Weighing only 9 lb. and adapted to such work as the drilling of holes up to ¾ in. in diameter, light chipping, hammering and vibrating a new and lighter model of the Syntron electric hammer which its manufacturer, the National Electric Manufacturing Co.,



Pittsburgh, has called Type F, has recently appeared on the market. It is similar to the two types already in use by manufacturers, contractors, central stations, and telephone companies.

The hammer has only one moving part, a reciprocating piston which moves in synchronism with the alternations of the electric current. On 60-cycle current it makes 3,600 strokes a minute against the head of the tool bit. For direct current, a rotary converter is furnished at a small additional cost.

The two sizes of Syntron hammers already on the market are Types A and B, weighing 17 and 26 lb. respectively, and capable of drilling 1 and 1¼-in. holes in hard concrete. The outfit is portable and can be attached to any electric light socket. The absence of motors, compressors, tanks, gears, and other equipment makes its design simple. Anyone of the three types will consume no more current than the ordinary domestic electric flat-iron, or less than ½ kw.

Publications from the Construction Industry

Plastering—U. S. DEPARTMENT OF COMMERCE, Washington, D. C., has just published as Circular 151 a 66-p. pamphlet entitled "Wall Plaster: Its Ingredients, Preparation, and Properties." The publication is based on the results of investigation and research by the Bureau of Standards in addition to collected and correlated information from the trade. The information given is both theoretical and practical and will prove useful to engineers, contractors and others engaged in the building industry. The text discusses such subjects as furring, lath and plastering materials, mixing and application, types and causes of defects, and proper selection of materials.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 139 to 153, are the following:

Bank and office, Tokio, Japan, to J. Stewart and Co., New York City, $7,500,000.

Water supply, Newark, N. J., to C. F. MacAvoy, $3,318,990.

Art museum, Philadelphia Pa., to G. A. Fuller Co., $1,892,000.

Hotel, Paterson, N. J., to John W. Ferguson, $1,000,000.

Paving, Baltimore, Md., to American Paving and Contracting Co., P. Flanigan & Son, and Baltimore Asphalt Block & Tile Co., $1,000,000.

Stadium, Minneapolis, Minn., to J. Lech, $537,762.

Street Improvement, Lakeland, Fla., $900,000.

Call money raised from 4½ to 4¾ per cent, March 10.

Time loans slow ranging from 4¾ to 5 per cent.

Commercial paper, all names at 4¾@5 per cent.

Recent Unit Bids From Large Contracts

Acquaintance with construction cost in various parts of the country may be had by studying the unit prices in awarded contracts published weekly in the Construction News section of *Engineering News-Record.*

The accompanying tabulation of unit prices of various materials and operations has been compiled from important contracts awarded during the past six weeks.

UNIT PRICES ON IMPORTANT MATERIALS AND OPERATIONS IN RECENTLY AWARDED CONTRACTS

Waterworks				
Minneapolis, Minn.	Feb. 21	5,000 ¾ in. corporation cocks	$0.72 each	Mueller Mfg. Co., Decatur, Ill.
		4,000 ¾ in. curb cocks	1.86 each	
Pueblo, Colo.	Feb. 21	4 mi. 36 in. creosote wood stave pipe	$98,000	Fed. Pipe & Tank Co., Seattle, Wash.
Madison, Wis.	Feb. 21	Motor driven deep well pump complete, 1,200 g.p.m.	$5,497	Aurora Pump & Mfg. Co., Aurora, Ill.
Excavation and Dredging				
Long Beach, Calif.	Feb. 21	2,000,000 cu.yd. dredging	$0.1618 per cu.yd.	United Dredging Co., Los Angeles, Calif.
Streets and Roads				
Leland, Miss.	Feb. 21	Paving 70,000 sq.yd. 1½ in. Willite top 1 in. binder on 5 in. conc.	$2.45 per sq.yd.	R. G. Lassiter, Norfolk, Va.
Vicksburg, Miss.	Feb. 21	Paving 61,000 sq.yd. brick on conc. and curb	$3.688 per sq.yd.	E. A. Finch, Hattiesburg, Miss.
Baton Rouge, La.	Feb. 21	Paving 80,000 sq.yd. 2 in. Warrenite bitulithic on 5 in. conc.	$2.80 per sq.yd.	Valleant & Toomer, Ft. Worth, Tex.
		20,000 sq.yd. 3 in. Vertical fibre brick on 5 in. conc.	3.40 per sq.yd.	
Des Moines, Ia.	Feb. 21	Paving 5.223 mi. 21,542 cu.yd. excav.	$0.65 per cu.yd.	Wright Constr. Co., Des Moines, Ia.
		2,020 cu.yd. excav.	.80 per cu.yd.	
		61,289 sq.yd. paving	2.385 per sq.yd.	
Oakland, Ia.	Feb. 21	Curbing and guttering	0.93 per lin.ft.	Union Constr. Co., Des Moines, Ia.
		Vibrolithic conc. paving	2.65 per sq.yd.	
Pine Bluff, Ark.	Feb. 21	33,000 sq.yd. conc. pave.	2.19 per sq.yd.	C. E. Philpot Pine Bluff, Ark.
Amarillo, Tex.	Feb. 21	Paving 3 in. brick on 4 in. conc	$3.20 per sq.yd.	Plains Paving Co., Amarillo, Tex.
		3 in. brick on 5 in. conc.	3.30 per sq.yd.	
		Curb and gutter	1.08 per lin.ft.	
Houston, Tex.	Feb. 21	1.55 mi. grading and gravel surfacing 16 ft.	$27,504	B. S. Davidson, Houston, Tex.
		1.56 mi. bit. topping 16 ft.	6,248	Haden & Austin, Houston, Tex.
Oregon	Feb. 21	27 mi. gravel surfacing	$25,050	Lyons & Pierce, Spokane, Wash.
Los Angeles, Calif.	Feb. 21	560 sq.ft. asphalt	0.35 per sq.ft.	Warren Constr. Co., Los Angeles, Calif.
		543,609 sq.ft. conc.	0.23 per sq.ft.	
		2,104 sq.ft. conc.	0.30 per sq.ft.	
		78,216 sq.ft. Warrenite bit. surf.	0.227 per sq.ft.	
		1,481 ft. curb	0.75 per ft.	
		4,336 sq.ft. gutter	0.32 per sq.ft.	
Lumber				
Leavenworth, Ind.	Feb. 21	80,000 ft. yellow pine for dam	$45.75 per M.	T. E. Rechtin, Evansville, Ind.
Tipton, Ia.	Feb. 21	244,800 ft. fir lumber for bridge	$41.98 per M.	W. W. Saylor, Waverly, Ia.
Conduit				
New York, N. Y.	Feb. 21	52,000 cu.yd. earth excav. and refill	$3.00 per cu.yd.	P. F. Connolly Co., Cleveland, O.
		4,000 cu.yd. rock excav.	2.00 per cu.yd.	
		10,000 lb. structural and rein. steel	0.10 per lb.	
Sewers				
Stroud, Okla.	Jan. 14	1,430 ft. 8 in. vit. sewer pipe	0.45 per ft.	H. L. Cannady Co., Tulsa, Okla.
		3,820 ft. 10 in. vit. sewer pipe	.60 per ft.	
		5,140 ft. 12 in. vit. sewer pipe	.77 per ft.	
		550 ft. 15 in. vit. sewer pipe	1.00 per ft.	
		80 ft. 10 in. c.i. pipe	2.50 per ft.	
		400 ft. ¾ in. gal. i. pipe	.35 per ft.	

Production of Basic Building Materials Increased During Month

Reserve Stocks Sufficient With Exception of Pine Timbers, Maple Flooring and Western Hollow Tile

Pig Iron—The February output for the entire country totaled 3 074,000 gross tons, against 3 018,000 during the preceding month and 2,994 000 for the corresponding period in 1923. The February production total is 20 per cent below the May, 1923 record output of 3,867,000 gross tons.

Steel—The steel ingot output for February totaled 3 604,862 tons, against 3,432,541, during the preceding month and 3,294,264 tons for the corresponding period in 1923. February, 1924 production, however, was about 10 per cent under the high peak of 1923, which occurred in May. The following table shows the monthly production records of the American Iron and Steel Institute:

Month	Tons
1923	
Jan.	3,644,629
Feb.	3,294,264
Mar.	3,858,675
Apr.	3,760,997
May	4,000,695
June	3,574,567
July	3,350,829
Aug.	3,506,755
Sept.	3,173,801
Oct.	3,382,986
Nov.	2,969,012
Dec.	2,711,529
Total	$41,228,739
1924	
Jan.	3,432,541
Feb.	3,604,862

Unfilled orders on books of the U. S. Steel Corporation, Feb. 29, totaled 4,912,901 tons, against 4,798,429, Jan. 31 and 7,283,989 tons, Feb. 28, 1923. The high record for unfilled tonnage occurred in April, 1917, with orders for 12,183,083 tons on hand at the end of the month.

Lumber—Compared with a year ago, the present lumber situation is one of increased production and shipments and lessened demand. The same holds true when the current movement is compared with a month ago. Production, however, is a trifle above normal; shipments are about 98 per cent and orders, 90 per cent of normal production. The lumber movement for the entire country, according to the National Lumber Manufacturers' Association, is shown in the following table:

	Four Weeks Ending Feb. 23, 1924 M. Ft., B.M.	Four Weeks Ending Jan. 26, 1924 M. Ft., B.M.	Four Weeks Ending Feb. 24, 1923 M. Ft. B.M.
Cut	972,224,349	799,996,286	785,022,079
Shipments	1,021,449,432	891,496,824	980,852,638
Orders	947,625,513	1,020,180,410	1,042,652,940

Cement—February production is estimated at 9,000,000 bbl. for the entire country as against 8,788,000 for the month preceding and 8,210,000 bbl. for the corresponding period in 1923. Of the quantity produced during February, between 5,000,000 and 6,000 000 bbl. were shipped from mills throughout the country, leaving stocks on hand Mar. 1, at approximately 16,000,000 bbl. The following table shows the cement movement for the country, according to the Geological Survey:

1923	Production (Barrels)	Shipments (Barrels)	Stocks on Hand at End of Month (Barrels)
Jan.	7,990,000	5,628,000	11,477,000
Feb.	8,210,000	6,090,000	13,596,000
Mar.	9,880,000	10,326,000	13,045,000
Apr.	11,359,000	12,954,000	11,463,000
May	12,910,000	14,257,000	10,144,000
June	12,382,000	13,307,000	9,168,000
July	12,620,000	13,712,000	8,081,000
Aug.	12,967,000	14,971,000	6,080,000
Sept.	13,109,000	13,698,000	5,533,000
Oct.	13,350,000	14,285,000	4,612,000
Nov.	12,603,000	10,251,000	6,991,000
Dec.	9,997,000	6,408,000	10,575,000
Total	137,377,000	135,887,000	.....
1924			
Jan.	8,788,000	5,210,000	14,153,000
Feb.	* 9,000,000	* 6,000,000	* 16,000,000

* Estimated.

Brick—Reports from the Common Brick Manufacturers' Association of America as of Feb. 1, 1924, show fewer burned and unburned brick on hand as compared with the month preceding. Fewer brick, however, were moved from yards during the month. The current brick situation compared with a month ago and one year ago, is shown in the following table:

	Burned Brick on Hand	Unburned Brick on Hand	Brick Moved from Yards During Month	Orders on Books
1924				
Feb. 1	306,503,000	38,349,000	45,762,000	272,403,000
Jan. 1	313,696,000	55,646,000	66,199,000	266,914,000
1923				
Feb. 1	199,449,000	25,326,000	.....	238,486,000

Stocks of basic building materials are sufficient to meet the spring demand with the possible exception of certain grades of lumber and hollow building tile. Taking the country as a whole, the only sections showing the slightest scarcity at mills or in dealers' warehouses, are the South and the Middle West. In the New Orleans district there is a reported scarcity of long leaf yellow pine, due to the decrease in production caused by heavy rains. There is also less maple flooring on hand than a year ago. In the Detroit district, reserve stocks of hollow tile are low; in fact Western quotations are higher than a month ago owing to scarcity. In the New York district, building materials are plentiful despite brisk demand. During the last week in February, about 2,000,000 common brick and 2,000 bbl. of cement arrived at the port of New York from Europe. Increased production of domestic materials had already rendered the local market safe from the shortage usually occurring in the spring.

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers have been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number is given.

Singapore plans extensive building program. The construction projects include a $2,500,000 post office; $3,000,000 hospital, buildings for bank and insurance company to cost $1,000,000; municipal buildings $1,000,000; and an extensive replanning of streets and roads. Reference No. 117,544.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 2,000,000); time required for delivery of carload lots to city job, example: (Hollow tile, Atlanta, deliveries take 4@5 days); and stocks on hand in general terms, example: (Sewer pipe, Detroit, plenty.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	New Orleans	Atlanta	New York
Sewer pipe	Stocks in usual good condition	No shortage	Still slight shortage	Ample	Plenty, all sizes	Satisfactory demand small	Del. take 4 to 5 days	Plenty, all sizes
Cement	Fairly well supplied	All plants active	Enough	Plenty in local warehouses	Ample for present needs	Plenty	About 50 to 60 cars	Enough; demand heavy
Lime	Stocks in fair shape	All plants active	Sufficient	Normal	Well supplied from local and Ohio kilns	Ample	About 50 to 60 cars	Market well supplied
Common brick	Dealers' stocks in good shape	Demand well supplied	2,000,000	Readily obtainable from nearby sources	Moderate supply in local yards	Sufficient	Plenty	Enough in storage to last till spring; Hudson River brick coming in
Hollow tile	No shortage	Meeting demand	Stocks replenished	Del. on short notice from nearby plants	Small quantity carried in stock	Enough	Del. take 4 to 5 days	Del. by water from nearby plants
Lumber	Over supply mostly fir	Heavy shipments from North Pacific coast	Normal	Well stocked	Dealers' stocks moderate	Pine stocks small	Plenty pine	Del. take 5 to 6 weeks from mill
Asphalt	Very large native reserves	Supplies meet steady demand	Sufficient	Ample	Sufficient for immediate needs	No market	30 to 40 cars on sidings	Heavy reserves in N. J.
Structural steel	Small supply of rivets and black steel sheets	Sufficient for requirements	Warehouses well stocked	Enough in warehouses	Plenty in local warehouses	Satisfactory quantity; demand small	About 3 or 4 cars	Small tonnage sales not affecting warehouse stocks

Brazil to have new aviation base. The government of Brazil has let to a native firm of contractors a contract for the construction of a naval aviation base. The contracting company is known to be friendly to American exporters and during 1922 imported nearly $1,000,000 worth of construction materials and equipment from this country. Reference No. 119,221.

Two American club buildings to be erected in Shanghai. The American Club and The Columbia County Club to erect buildings that will be modern in all details. Reference No. 119,410-11.

Modern improvements for a city in Sonora, Mexico. The installation of a sewerage system, a public school building, and modern fire apparatus is contemplated. It is suggested that American manufacturers of school supplies, automotive fire apparatus and construction engineers get in touch with those responsible for the purchase through the American Consulate. Reference No. 120,193 (Consul Henry C. A. Damm, Nogales, Sonora, Mexico.)

Hospital for Mukden, China. There are to be 28 buildings and will cost about $45,000 a year for upkeep when completed. Reference No. China 35x-b.

Bids invited for port work in Chile. The building of extensive port works at Constitucion, Chile, has matured so that the Ports Commission at Santiago has made a third request for tenders. Complete specifications in Spanish with terms of contracts and detail maps available at the New York District Office, 734 Custom House, New York City.

Manchurian railway company of North China to spend approximately 45,000,000 yen (a yen equal to about $0.457). Reference No. China 35x-c.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Mar. 6; the next, on Apr. 3.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$3.85	—$4.20
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.00	5.15	5.00	4.05	—5.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.25	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	+53.7%	43%	47%	55.05%	36%	37.10@47.40%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	56.00	61.00	57.20@60.20	61.50	69.00	60.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	2.72
Gravel, ¾ in., cu.yd.	2.00	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.40	2.00	2.00	1.25@1.50	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+65.00	40.00	54.75	—55.00	42.75@44.00	—41.75	36.00	29.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	23.65@25.85	12.00	11.60	11.00	—14.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.091	.11	.064	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.091	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.97	1.05	+1.15	.94	—1.06	+1.16	—1.06	1.15	1.18
Common Labor:									
Common labor, union, hour	.75	.30	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	.40@.45	.35@.50	.50	.62½	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 280-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 96.37). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

Few price changes have occurred during the week in the basic building materials market. A slight weakening of steel prices is reported from Montreal, while pine timbers are $3 per M. ft. lower in Chicago than on Feb. 28. Douglas fir, also dropped considerably in Denver during the two weeks. Long leaf yellow pine timbers are at present $5 per M. ft. higher in New York than during the last week in February. A seasonal dullness in the Minneapolis brick market is reflected in a drop of $1.50 per M. since Mar. 7. Fluctuation continues in the linseed oil market consequent to a shortage of flax.

Common labor is reported slightly easier to obtain in Atlanta; the minimum rate is now 25c. per hr., against 30c., last month. Bricklayers in Denver have been advanced to $12 per day, from a minimum rate of $11.

Telegraphic reports to *Engineering News-Record* from points along the Pacific coast, show a tendency toward over production in the lumber mills, with the consequent closing down of many plants. Marked activity, however, is reported in highway, bridge and residential construction.

The present price of cement in Chicago ($2.20 per bbl.) is nearly 7 per cent below the price prevailing in October of the peak year 1920. Although June, 1920, marked the point at which most building materials reached the maximum level, cement at that time in Chicago was $2.15 per bbl., to contractors, exclusive of the cost of bags.

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